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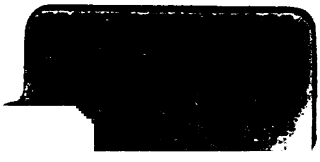

SEVENTEENTH ANNUAL REPORT

OF THE

Maine Agricultural Experiment Station

ORONO, MAINE,

1901.

AUGUSTA
KENNEBEC JOURNAL PRINT
1902

The Bulletins of this Station will be sent free to any address in Maine. All requests should be sent to

Agricultural Experiment Station,
Orono, Maine.

STATE OF MAINE.

A. W. Harris, Sc. D., President of the University of Maine:

SIR:—I transmit herewith the Seventeenth Annual Report of the Maine Agricultural Experiment Station for the year ending December 31, 1901.

CHARLES D. WOODS,
Director.

ORONO, ME., December 31, 1901.

MAINE

AGRICULTURAL EXPERIMENT STATION

ORONO, MAINE.

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†HERBERT W. BRITCHER,	*Assistant Zoologist*

* Resigned May, 1901.

† Appointed September, 1901.

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ANNOUNCEMENTS.

THE AIM OF THE STATION.

Every citizen of Maine concerned in Agriculture, has the right to apply to the Station for any assistance that comes within its province. It is the wish of the Trustees and Station Council that the Station be as widely useful as its resources will permit.

In addition to its work of investigation, the Station is prepared to make chemical analyses of fertilizers, feeding stuffs, dairy products and other agricultural materials; to test seeds and creamery glass-ware; to identify grasses, weeds, injurious fungi and insects, etc.: and to give information on agricultural matters of interest and advantage to the citizens of the State.

All work proper to the Experiment Station and of public benefit will be done without charge. Work for the private use of individuals is charged for at the actual cost to the Station. The Station offers to do this work only as a matter of accommodation. Under no condition will the Station undertake analyses, the results of which cannot be published, if they prove of general interest.

INSPECTIONS.

The execution of the laws regulating the sale of commercial fertilizers, concentrated commercial feeding stuffs, and agricultural seeds, and the inspection of chemical glassware used by creameries is entrusted to the Director of the Station. The Station officers take pains to obtain for analysis samples of all brands of fertilizers and feeding stuffs coming under the law, but the organized co-operation of farmers is essential for the full and timely protection of their interests. Granges, Farmers' Clubs and other organizations can render efficient aid by reporting any attempt at evasion of the laws and by sending, early in the sea-

son, samples taken from stock in the market and drawn in accordance with the Station directions for sampling. In case there should be a number of samples of the same brand sent in, the Station reserves the right to analyze only in part.

STATION PUBLICATIONS.

The Station publishes several bulletins each year, covering in detail its expenses, operations, investigations and results. The bulletins are mailed free to all citizens who request them. The Annual Report is a reprint of the bulletins of the year and is bound with the Report of the Board of Agriculture and distributed by the Secretary of the Board. The combined report for 1901 can be obtained by addressing the Commissioner of Agriculture, State House, Augusta, Maine.

CORRESPONDENCE.

As far as practicable, letters are answered the day they are received. Letters sent to individual officers are liable to remain unanswered, in case the officer addressed is absent. All communications should, therefore, be addressed to the

Agricultural Experiment Station,
Orono, Maine.

The post office, railroad station, freight, express and telegraph address is Orono, Maine. Visitors to the Station can take the electric cars at Bangor and Old Town.

The telephone call is "Orono 5."

Directions, forms and labels for taking samples, of fertilizers, feeding stuffs and seeds for analysis can be had on application.

Parcels sent by express should be prepaid, and postage should be enclosed in private letters demanding a reply.

CHAS. D. WOODS, *Director.*

OATS AS GRAIN AND FODDER.

J. M. BARTLETT.

The oat crop ranks third in importance among American cereals in the United States and has a long lead as first in the State of Maine. In 1899 the State grew about 141,600 acres, which was six times as much land as was devoted to any other cereal, and about 5,000,000 bushels of the grain were raised. Owing to the low price and uncertain yield of wheat in recent years, the acreage devoted to oats has greatly increased.

Formerly the oat grain was only used as food for animals but now it holds a prominent place among nutrients for man. The grain varies quite widely in composition and weight. In the southern portions of our country it is much coarser, contains more hull, and is consequently more bulky, a measured bushel weighing sometimes as little as twenty pounds, while the northern grown grain frequently weighs over forty pounds. The quality and composition is also considerably affected by climatic conditions, such as moisture, heat and cold, etc.

The oat plant succeeds best in a cool, moist climate such as is found in northern and eastern Maine, the Provinces, and Prince Edward's Island. It will grow on most all kinds of soil, from light gravelly loam to stiff clays and peats. The oat is a great forager and will grow on poorer soil than wheat or barley. It thrives best and matures the plumpest grain on rather light soil well supplied with moisture, and sufficiently early to allow the oats to be sown the last of April or first of May. Late sown oats are liable to rust before the grain matures.

INFLUENCE OF MANURE ON OATS.

Although oats will grow and yield moderate crops on poorer soils than most other cereals, they respond readily and profitably to liberal applications of manure. Too heavy applications of stable manures or nitrogenous fertilizers are liable to cause an excessive growth of straw at the expense of the grain. Oats require less nitrogen than wheat, and are greatly benefitted by liberal quantities of phosphoric acid, and this fact should be borne in mind in preparing land for them. If stable manure is employed, only a

light coat should be added and then a supplementary dressing of acid phosphate applied. In using commercial manures alone, it is always best to use a complete manure unless the land has previously been well supplied with nitrogen from stable manures or some leguminous crop like clover or peas turned under, in which case, only phosphoric acid and potash need be applied with perhaps a little nitrate of soda to furnish soluble nitrogen to start the plants early. For a complete fertilizer it is recommended to use one carrying about 2.5% nitrogen, 8% available phosphoric acid, and 3% potash. A part of the nitrogen, at least .5%, should be in a soluble form as in nitrate of soda, and the remainder in some more insoluble form as tankage, ground fish or bone, in order that the young plant may be made vigorous and thrifty by the former, while the older plant can be kept growing by the latter. This recommendation is based upon results of a large number of experiments by Stoeckhardt which were repeated for several years. He found that when soluble nitrogen was lacking the crop did not prosper in the early stages of vegetation, and also when only soluble nitrogen compounds were used the growth fell off too soon after the plant had flowered. The experiments of both Stoeckhardt and Wolff show that a liberal supply of phosphoric acid is necessary to insure an abundance of plump, well-formed grain. Finely ground bone meal with small amounts of nitrate of soda and muriate of potash are recommended as a fertilizer for this crop.

OATS AS GRAIN.

Oats are a valuable feed for most all farm animals. The relatively large amount of fiber they contain in proportion to kernel, as compared with most other grains, makes them a safer feed with but little danger of over feeding, when put in the hands of careless workmen. They contain a higher proportion of digestible protein than corn or wheat and are lower in carbohydrate materials, consequently the nutritive ratio of the grain is such that it contains in itself a quite well-balanced ration for working animals. They are a very convenient and highly prized grain for feeding horses. They usually are and should be fed unground to horses, unless the animal is unable to masticate his food properly. Experience shows that oats give a horse "mettle,"

or stimulate him as no other of our grains do. They are consequently held without a peer by horsemen as feed for driving horses and may be made almost exclusively their diet.

A chemist by the name of Sanson claims to have discovered a stimulating principle, supposed to be an alkaloid, in the seed coats of the oat grains, varying in quantity in different varieties of oats and also with soil and climate in which they are grown, but later careful investigations by chemists have failed to discover any alkaloid, or nitrogenous compound of a stimulating nature. Nevertheless the belief is so prevalent among practical feeders that nothing gives so much "mettle" to the horse as oats, it seems evident that they must contain something which, if not a stimulant, acts much like one and makes oats admirably adapted by their nature to this class of animals. For growing colts or dairy stock there is no question but that other grains or combinations such as wheat bran, middlings, linseed, gluten meals, etc., are more economical at present prices, and just as efficient.

Many experiments have been made to test the practicability of using substitutes for oats as feed for horses. At Hohenheim, Germany, in 1893-94 feeding experiments were conducted in which beans and corn were substituted quite largely for oats, the proportions being two pounds oats, three pounds field beans, eight pounds corn. In Paris also the Paris Omnibus Company substituted beans, corn and oil cake for a large portion of the oats in the grain ration, with good results. The New Jersey Experiment Station made an experiment with street car horses in which dried brewers' grains were substituted for oats. The horses fed the grains, performed their work and kept in as good condition as those fed oats. The conclusions of the station authorities were: "That dried brewers' grains, pound for pound, were quite equal to oats in a ration for work horses. The results of the substitution was a saving of about five cents a day for each animal.

The North Dakota Station compared wheat bran and shorts with oats for feeding horses and mules at quite severe work. The conclusions drawn from the experiment were: That the mixture of shorts (middlings) and bran proved of equal worth to oats for the working animals.

The Maine Experiment Station in 1890-91 compared a mixture consisting of twelve parts wheat middlings, seven parts gluten

meal, three parts linseed meal, with oats as a grain ration for growing colts. The results of the two tests show that the mixed grain ration produced more rapid growth at less cost than the oat ration.

The above experiments show that other grains can be often profitably substituted for oats at present prices in rations for horses without detriment to the animal and a financial saving to the owner.

MAINE GROWN OATS.

In 1898 the writer, in estimating the food value of our different grains, had occasion to look up the composition of Maine oats and found that very few analyses of well authenticated Maine grown grain had been made, and as the composition of oats grown in different climates varies quite widely, the average analysis given for the whole country would not furnish very reliable data. Therefore it was considered advisable to collect samples of Maine grown oats from different parts of the State for analyses. The work was begun so late in 1898 that very few samples, five only, were obtained and very little data was given with them. Early in 1899 a circular was sent out to several parties in different parts of the State requesting samples and information as to methods of tillage, manuring, etc. Eleven samples were received from localities which represented nearly all the oat growing regions of the State.

The tables which follow give the data furnished by the growers of the oats as to previous treatment of the soil, its preparation for the crop, the dates of sowing and harvesting and the yield per acre. The weights of straws are largely estimates and therefore cannot be considered very accurate. The bushels are probably measured bushels and consequently would over run in the case of the heavy oats. The weights per bushel were estimated in the laboratory.

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The table on page 15 gives the chemical composition of the grain calculated to water content at time of receipt and also as calculated to a water-free basis.

ANALYSIS OF MAINE GROWN OATS. FROM WHOM OBTAINED, WHERE THEY WERE GROWN, THE KIND OF SOIL, AND KINDS OF CROPS GROWN ON THE LAND IN PRECEDING YEARS.

Station number of sample.	Furnished by.	Town Where Raised.	Kind of Soil.	Crops Raised on Land in	
				1897.	1898.
4142	Ansel Briggs	North Auburn	Rocky loam	Corn.	
4143	J. Benn	Hodgdon.			
4144	J. M. Winslow	Nobleboro.			
4145	O. B. & E. S. Poor	Andover	Clay loam	Hay	Oats.
4146	W. G. Hunton	Readfield.		Hay.	Oats.
4187	A. T. Griffin	Lincoln Center	Sandy loam		Corn and beans.
4188	J. M. Winslow	Nobleboro	Coarse rocky loam	Hay	Corn.
4189	C. A. Brown	Lincoln	Light clay loam	Hay	Potatoes, oats and corn.
4190	E. M. Gerald	Clinton.	Light clay loam	Hay	Hay.
4195	Y. W. Skelton	Bowdoin.	Light clay and sand	Hay	Potatoes, corn and oats.
4197	Lewis C. Kimball	Hermon	Gravelly	Potatoes and corn.	Potatoes and beans.
4198	G. W. Patten	West Pittsfield	Rocky poor loam	Hay	Hay.
4200	Lorimer McGlauflin	Charlotte.	Light loam	Oats.	Potatoes.
4201	Henry S. Balentine	Topsham.	Medium clay loam	Hay	Corn and potatoes.
4206	Oscar Shirley.	Houlton	Light clay loam	Hay	Potatoes.
4207	E. B. Owen	West Pembroke.	Light clay loam	Oats, barley and potatoes	Oats, barley and potatoes.

ANALYSIS OF MAINE GROWN OATS, MANURING, VARIETY, DATES OF PLANTING AND HARVESTING AND YIELDS PER ACRE

Station Number of Sample.	How Manured in 1898.	How Manured in 1899.	Seed.	Date of Sowing.	Date of Harvesting.	Yield of Grain per Acre—Bushels.	Yield of Straw per Acre—Tons.
4142	Light coat of manure					39½	
4143							
4144							
4145	12 cords manure to acre					50	
4146	Light coat of manure					36	
4187	Yard manure and fertilizer	500 pounds to acre Bradley's Eureka		May 15.	Sept. 1	46	2¼
4188	300 pounds fertilizer and 8 cords stable manure	None		May 8.	Aug. 1	42	3
4189	4 cords manure, 500 lbs. cheap fertilizer	Six cords manure	Scottish Chief	May 1.	Aug. 16	55	1½
4190	None	600 pounds Packer's Union Fertilizer	Liberty		Aug. 22	50	1¼
4195	Seven cords manure per acre	Six cords manure, 800 lbs. Crocker's Potato to acre	Western	May 10.	Aug. 23	59	1½
4197	Stable manure	Six cords stable manure to acre	Common	April 20.	Aug. 7	50	2
4198	None	500 pounds to acre Great Eastern	White Russian	May 15.	Aug. 15	46	1½
4200	Barn manure and Bradley Fertilizer	None	Parker Oats	May 10.	Aug. 17	60	2½
4201	Twenty loads stable manure per acre	Six cords stable manure	Common Western	May 11.	Aug. 14	50	2
4206	None	Fifteen tons barn manure	Siberian	May 1.	Sept. 5-10	56	2
4207	Fish pomace and barn manure	Four cords manure, 1000 pounds fish	Hogan	April 20.	Sept. 10	55	1

ANALYSES OF MAINE-GROWN OATS. COMPOSITION OF THE OATS ON CURED AND WATER FREE BASIS.

Variety.	Station number.	Weight per bushel.	Water.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.	Calories per gram.
ON CURED BASIS.		lbs.	%	%	%	%	%	%	
	4142	.....	8.39	3.03	10.63	13.92	59.27	4.76	4.247
	4143	.....	8.66	3.59	11.69	13.47	57.88	4.71	4.215
	4144	.....	8.73	3.01	13.00	12.13	58.20	4.93	4.270
	4145	.....	11.15	2.92	12.56	11.28	57.70	4.39	4.161
	4146	....	8.07	3.41	12.13	13.24	58.26	4.89	4.218
	4187	34	11.35	3.95	10.75	9.33	61.27	3.35	4.203
	4188	34	10.20	3.67	11.13	9.13	60.23	5.64	4.300
Scottish Chief	4189	33½	10.23	3.19	10.88	8.31	62.17	5.22	4.250
Liberty	4190	31½	10.18	3.43	11.38	9.19	60.28	5.54	4.232
Weston	4195	34½	10.92	3.08	11.25	8.64	60.25	5.86	4.285
Common	4197	35	9.84	3.42	9.93	10.29	61.13	5.39	4.258
White Russian	4198	34½	9.21	3.14	12.75	10.10	58.36	6.44	4.376
Parker Oats	4200	41½	11.69	2.91	11.56	10.62	57.29	5.93	4.294
Common Western	4201	32½	9.09	3.91	12.57	11.71	56.08	6.64	
Siberian	4206	37	11.16	2.85	12.12	9.18	59.03	5.66	
Hogan	4207	41	9.46	2.84	11.50	11.03	60.13	5.04	4.291
ON WATER FREE BASIS.									
	4142	.....	.....	3.31	11.60	15.20	64.70	5.19	4.636
	4143	.....	.....	3.93	12.80	14.71	63.40	5.16	4.614
	4144	.....	.....	3.30	14.20	13.30	63.80	5.40	4.607
	4145	.....	.....	3.28	14.09	12.70	64.99	4.90	4.683
	4146	.....	.....	3.71	13.19	14.39	63.39	5.32	4.588
	4187	.....	.....	4.46	12.13	10.52	69.11	3.78	4.741
	4188	.....	.....	4.09	12.39	10.17	67 07	6.28	4.788
Scottish Chief	4189	.....	.....	3.55	12.12	9.26	69.26	5.81	4.734
Liberty	4190	.....	.....	3.82	12.67	10.23	67.11	6.17	4.712
Weston	4195	.....	.....	3.46	12.63	9.70	67.63	6.58	4.810
Common	4197	.....	.....	3.79	11.01	11.41	67.81	5.98	4.723
White Russian	4198	.....	.....	3.46	14.04	11.12	64.29	7.09	4.820
Parker Oats	4200	.....	.....	3.30	13.09	12.03	64.87	6.71	4.862
Common Western	4201	.....	.....	4.30	13.83	12.88	61.69	7.30	
Siberian	4206	.....	.....	3.21	13.64	10.33	66.45	6.37	
Hogan	4207	.....	.....	3.14	12.70	12.18	66.42	5.56	4.739

In the above table, where the weight per bushel of most of other samples are given, it will be noticed that contrary to the common belief the light oats show about as good chemical composition as the heavy ones. Therefore the food value of a bushel (32 pounds) of light oats is about the same as 32 pounds of heavy oats, and it seems to matter little whether oats weigh 32 or 40 pounds to the measured bushel if they are bought and fed by weight. Probably exceedingly light oats like those grown in the

south, weighing much under 30 pounds, would contain a larger proportion of crude fiber and consequently less nutritive value; therefore the above statement as to feed value would only be true as regards northern grown, or the heavier oats, weighing over 30 pounds to the measured bushel.

OATS AS HAY.

It is quite a common practice with many farmers to harvest oats before the grain is mature and cure them for coarse fodder. This is a very desirable plan to follow at times when the hay crop is short, or in localities where the land is badly infested with noxious weeds like the Canada thistle or wild mustard, both of which should be cut before they seed.

The oat plant, however, is not an ideal one for making hay. The stalks are hollow, coarse and hard, and unless dried very quickly in a bright sun they become bleached, even when cut green, so that they look little better than straw. To cure the crop in its best condition and retain its bright green color and palatability, it should be dried in a bright sun for a few hours, with liberal use of the hay tedder when there is a heavy growth; then raked together and the curing completed in the windrow or cock, with as little exposure to moisture as possible. If the weather is unfavorable, as is frequently the case during the latter part of July or first of August when oats are mature enough to cut for hay, they are very liable to be seriously injured and rendered unpalatable.

Oats, however, when not sown too thickly, have an advantage over other plants, which make more desirable hay, of being a fairly good catch crop for seeding to grass, as they mature early enough to allow the young grass to get a good start in the fall, and for this reason are desirable on the farm.

It is quite well known, and there is considerable experimental data showing that most plants like the grasses, clovers, etc., usually grown for hay are at their best to harvest when in bloom, but as regards oats there is very little available information indicating at what stage of growth they should be cut for hay making. Accordingly some experiments were undertaken to determine the comparative value of oat hay cut at different stages of maturity. In 1897 a section of a field of oats was set apart for these tests. The portion selected was covered with a fairly uni-

form growth and the oats in all parts of it appeared at about the same stage of maturity. The piece was then divided into three equal sections. One of these sections was cut on July 27th when the oats were in bloom. A second section was cut one week later, August 5th, when nearly all the kernels were in the milk stage, and the third August 12th when nearly all the grains had passed to the dough stage of maturity, the tops and upper portion of the stalks were green, but the lower portions showed signs of ripening. When cured this cutting made nearly as good looking hay as the other two sections, but evidently was not as palatable as it was not as readily eaten by the sheep. Care was taken in curing all the cuttings to avoid exposure to moisture, all were dried as quickly as possible and then stored in the barn until needed for further work.

To estimate the increased yield from the growth of the crop during the time that elapsed between the cuttings, three sections, each 10 x 15 feet, were taken in different parts of the large plats. One third, five feet of the length, was cut each time that cuttings were made from the larger sections, carefully dried and the dry matter determined in each, which is given in pounds per acre.

Dry matter of 1st cutting per acre, 4418.8 pounds.
Dry matter of 2d cutting per acre, 5218.3 pounds.
Dry matter of 3d cutting per acre, 4571.0 pounds.

The composition of the hays cut at different stages of maturity is shown in the tables on pages 21 and 22.

The composition of three different sections of the oat plant is also given in the same tables. These studies were made in order to determine at what distance from the ground the oats should be cut, as well as what loss occurs by leaving a long stubble. Some plants 3½ to 4 feet high were cut close to the ground and then divided into three sections, one of which was the first eight inches of the lower part of the stalk, another the second eight inches, and the third, the remainder of the plant or top. An inspection of the tables shows a marked difference in composition of the different sections. The bottom section has very little food value, containing only 2.77% protein and 1.90% fat, both of which are probably not more than 40% digestible. The second section has only about

half the protein of the top section and its digestibility is probably less. It would, therefore, be advisable to leave a high stubble, not less than 8 to 10 inches of plants 3 to 4 feet high in harvesting, and the loss incurred by leaving the coarser part of the stalks on the ground will be more than compensated by the improved quality and palatability of the hay.

OATS AS SILAGE.

Oats will make a very fair quality of silage when properly put in the silo, but the plant from the nature of its structure is not well adapted to the process of ensiling. The stalks being hollow carry, when not crushed or broken, a large amount of air into the mass which prolongs fermentation to the detriment of the quality of the silage. It therefore is necessary to run such materials through the silage cutter to obtain the best results. Although the plant is not an ideal one for the purpose, it is often desirable to put a field of oats into the silo on account of the presence of noxious weeds, rust, bad weather for drying at time of harvesting, or for other reasons. The station farm silos have several times been filled with this material. To avoid expense, the oats were at first put into the silo without cutting them in the silage cutter. All usual precautions of packing well at the sides and corners were observed in filling, and after full the silos were well covered, and weighted. In storing by this method, much of the silage spoiled and the remainder was not first quality. Subsequently the silos were filled several times with oats and peas run through the silage cutter, and the materials kept perfectly, coming out in green, nice condition and were as well relished by cattle as corn silage.

OAT AND PEA HAY.

Oats and peas grown together and harvested when the oats are in the early milk stage make a forage crop very much superior to oats alone for either hay, soiling, or silage. As peas are a leguminous plant they increase the protein of the fodder, and also improve the soil by leaving behind, in their roots and stubble, a part of the nitrogen which they take from the air. By growing the mixture then, both the fodder and the soil are improved, whereas if oats are grown alone a rather poor fodder is obtained

and the soil reduced in fertility. This combination makes one of the best soiling crops for feed in July and August before corn or Hungarian is mature enough to cut. If the crop is allowed to mature and the two grains are ground together, the result is a most excellent feed for dairy cows and is much used by Canadian farmers. The chief objection to the material for making hay is that it dries rather slowly. The pea vines are like clover in this respect and should be cured in much the same manner, in the windrow or cock. When well cured without too much exposure to moisture and sun it makes a fodder fully equal to our best English hay. In case of bad weather the silo can be resorted to as a means of caring for the crop, but the material should be run through a silage cutter before ensiling, otherwise it is liable to be poorly preserved. In sections of the State where corn cannot be grown on account of frosts, peas and oats make a valuable substitute with which to fill the silo. For composition and digestibility of oat and pea silage see pages 21-23.

The amount of seed to apply depends somewhat on the condition of the land and whether it is to be seeded to grass. The usual amounts sown are 1½ bushels oats and 1½ bushels peas to the acre, but several plots were grown on the Station farm with good success on fairly good soil, with a seeding of one bushel oats and two bushels peas to the acre. Three different varieties of peas were used and the yields of cured hay are given below.

Oat and Canada blue pea hay, 5,440 pounds to an acre.

Oat and Canada white pea hay, 5,408 pounds to an acre.

Oat and Mummy pea hay, 5,952 pounds to an acre.

For composition and digestibility see pages 21-23.

BY-PRODUCTS OF THE OAT.

In the manufacture of oat products for human food, the kernel of the oat is separated from the hull. Oat hulls are in themselves, low in food value, being worth but little more than the same weight of oat straw. Their value may be materially greater if broken kernels or small oats are ground in with them. Manufacturers of oat products are putting ground oat hulls on the market in many forms and mixtures, such as oat feed, oat chop, corn and oat feed, chop, etc. The bulk of all these materials is ground oat hulls, with admixtures of oat kernels, ground

corn, etc. The feeding value of them is variable, and they should never be bought except on a guaranteed composition, and then it should be remembered that the oat hulls are not as digestible as the kernel of oats or other grains. Unscrupulous dealers frequently sell "oat feeds" as ground oats, the unsuspecting buyer thinking he is getting the whole oat meal, which is much more valuable than most oat feeds.

Very few farmers can afford to buy feeds low in protein and high in carbohydrates at any price at which they have been or are likely to be offered. The farmer should grow all the coarse feeds that he needs. Oat and similar feeds are very much like corn stalks or oat straw in composition. Some of the feeds have cottonseed or other nitrogenous feeding stuffs added to them so that they carry more protein than straight oat feeds, but these mixtures are always more expensive sources of protein than are the glutens, cottonseed and linseed meals. One hundred pounds of an ordinary oat feed has from eight to eleven pounds protein. At seventy-five cents per hundred the protein costs from seven to nine cents a pound. One hundred pounds of a good gluten meal has from thirty-four to forty per cent of protein. At $1.30 per hundred the protein costs about three cents a pound and it not only costs less than half as much as that of the oat feed but it is better digested.

The tables which follow give the analyses of oat hays cut at different stages of growth, of different parts of the oat plant, of oat and pea and oat and vetch hays, and oats and oat products used in digestion experiments from which the digestion coefficients in the table on page 23 were obtained.

ANALYSES OF OAT PRODUCTS CALCULATED TO WATER CONTENT AT TIME OF SAMPLING.

Kind of Material.	Station number.	Water.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
Oat hay, cut when in bloom...	*4097	16.00	77.66	6.34	8.28	30.85	36.44	2.11
Oat hay, cut when grain was in milk	*4096	16.00	78.67	5.23	8.89	26.49	40.66	2.73
Oat hay, cut when grain was in dough	*4089	16.30	78.49	5.21	6.47	26.58	42.60	2.84
Oat hay, cut when part of heads were in bloom, part in milk.	*4127	13.76	79.91	6.33	8.80	28.87	39.38	2.86
Oat hay, cut when part of heads were in milk, part in dough.	*4130	13.28	80.47	6.25	6.59	29.45	41.13	3.30
Oat hay, first 8 inch section of bottom of stalk...	4134	9.80	84.03	6.17	2.50	39.23	40.58	1.72
Oat hay, second 8 inch section of stalk.....	4135	10.00	82.65	7.35	4.31	37.43	38.91	2.00
Oat hay, top of plant.....	4133	11.33	82.45	6.22	8.53	24.68	45.88	3.36
Oat and pea hay.....	*4174	14.50	77.51	7.99	14.41	26.84	33.69	2.57
Oat and pea silage.	*4202	73.80	24.15	2.05	3.34	8.75	10.45	1.61
Oat and vetch hay.....	*4217	20.00	73.93	6.07	8.51	24.93	37.68	2.81
Oat and pea hay	*4222	25.08	68.99	5.93	10.31	25.01	31.45	2.22
Oats.	*4145	11.15	85 93	2.92	12.56	11.28	57.70	4.39
Oats	*4234	13.16	83.69	3.15	11.38	10.31	57.06	4.94
Royal Oat Feed	*4245	10.37	83.90	5.73	6.69	22.39	51.74	3.08
Oat straw.	27	10.00	86.33	3.67	3.56	37.80	42.00	3.00
Oat and Canada blue pea hay.	4184	14.84	78.91	6.25	9.78	25.42	40.90	2.81
Oat and Canada white pea hay	4185	16.00	78.12	5.88	10.58	24.60	39.97	2.97
Oat and mummy pea hay.....	4186	14.83	79.70	5.47	9.21	25.72	41.86	2.91
Oat and spring vetch hay.....	4183	11.53	82.27	6.20	9.14	27.28	43.12	2.73

* The materials from which these samples were taken were used in the experiments from which the digestion coefficients in the table on page 23 were obtained.

ANALYSES OF OAT PRODUCTS CALCULATED TO DRY MATTER (WATER-FREE SUBSTANCE).

Kind of Material.	Station number.	Dry matter.	Water-Free.					
			Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
		%	%	%	%	%	%	%
Oat hay, cut when in bloom..	*4097	73.54	92.45	7.55	9.86	36.70	43.38	2.51
Oat hay, cut when grain was in milk	*4096	73.41	93.77	6.23	10.58	31.53	48.41	3.25
Oat hay, cut when grain was in dough	*4089	83.70	93.77	6.23	7.73	31.74	50.91	3.39
Oat hay, cut when part of heads were in bloom, part in milk	*4127	86.24	92.66	7.34	10.20	33.48	45.66	3.32
Oat hay, cut when part of heads were in milk, part in dough	*4130	86.72	92.79	7.21	7.60	33.96	47.42	3.81
Oat hay, first 8-inch section of bottom of stalk	4134	90.20	93.16	6.84	2.77	43.49	45.00	1.90
Oat hay, second 8-inch section of stalk	4135	90.00	91.84	8.16	4.79	41.60	43.23	2.22
Oat hay, top of plant	4133	88.67	92.99	7.01	9.62	27.83	51.75	3.79
Oat and pea hay	*4174	85.50	90.65	9.35	16.85	31.39	39.41	3.00
Oat and pea silage	*4202	26.20	92.17	7.83	12.74	33.40	39.90	6.13
Oat and vetch hay	*4217	80.00	92.41	7.59	10.64	31.16	47.10	3.51
Oat and pea hay	*4222	74.92	92.09	7.91	13.76	33.38	41.99	2.96
Oats	*4145	88.85	96.72	3.28	14.09	12.70	64.99	4.94
Oats	*4234	86.84	96.37	3.63	13.10	11.87	65.71	5.69
Royal Oat Feed	4245	89.63	93.61	6.39	7.46	24.98	57.73	3.44
Oat straw	27	90.00	95.92	4.08	3.95	42.00	46.67	3.30
Oat and Canada blue pea hay.	4184	85.16	92.66	7.34	11.48	29.85	48.03	3.30
Oat and Canada white pea hay	4185	84.00	93.00	7.00	12.60	29.28	47.59	3.53
Oat and mummy pea hay	4186	85.17	93.58	6.42	10.81	30.20	49.15	3.42
Oat and spring vetch hay	4183	88.47	81.46	7.01	10.33	30.83	48.74	3.09

*The materials from which these samples were taken were used in the experiments from which the digestion coefficients in the table on page 23 were obtained.

THE DIGESTIBILITY OF OAT PRODUCTS.

In additional to the chemical study of oats and oat products reported in the preceding tables, digestion experiments with sheep were made with the food materials the laboratory numbers of which are marked with the asterisk. The full data of these digestion experiments have been printed in previous publications of the Station. The final results of the coefficients thus obtained are given in the table which follows:

DIGESTION COEFFICIENTS OBTAINED FOR OAT PRODUCTS.

	Station number.	Dry matter.	Organic matter.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.
		%	%	%	%	%	%	%
Oat hay, cut when in bloom...	4097	54.3	53.7	48.6	53.5	59.9	51.2	48.3
Oat hay, cut when grain was in milk	4096	52.8	54.0	34.1	58.6	50.3	55.0	62.3
Oat hay, cut when grain was in dough	4089	53.8	54.8	41.0	44.7	49.4	59.1	64.5
Oat hay, cut when part of heads were in bloom, part in milk	4127	55.9	57.3	37.7	63.6	54.5	57.5	63.3
Oat hay, cut when part of heads were in milk, part in dough	4130	55.2	56.6	38.2	47.6	52.5	59.7	71.6
Oat and pea hay	4174	64.2	62.5	58.2	72.2	63.0	63.7	54.4
Oat and pea silage	4202	65.5	66.6	52.4	74.6	61.3	67.0	75.0
Oat and vetch hay	4217	60.1	60.2	60.2	69.5	51.5	62.7	73.8
Oat and pea hay..	4222	58.5	58.5	59.1	74.7	51.8	57.6	64.8
Oats	4145	69.2	71.3	.....	75.5	30.8	77.2	
Oats	4234	71.5	72.5	44.5	78.9	31.2	77.3	89 3
Royal Oat Feed.....	4245	47.3	48.1	37.4	69.1	33.1	50.9	88.2

DIGESTIBLE NUTRIENTS IN DRY MATTER OF OAT PRODUCTS.

In order to compare the feeding values of different food materials, the digestible rather than the total nutrients must be taken into account. This is done in the following table which shows the percentage of digestible nutrients in the different oat products here reported upon.

The results of the experiments indicate that the nutrients of oat hay are in the most digestible form when the heads are in milk. If cut in bloom there is a less yield of poorer composition and digestibility than when cut in milk. If the cutting is delayed till the oats are in the dough stage, the slightly larger yield is more than offset by the poor quality and lessened digestibility of the hay.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
Oat hay, in bloom	45.6	41.7	3.10	4.43	18.48	18.66	1.02
Oat hay, in milk	44.4	42.5	1.78	5.21	13.33	22.39	1.70
Oat hay, in dough	45.0	43.0	2.14	2.89	13.14	25.18	1.83
Oat hay, bloom and milk	48.2	45.8	2.39	4.80	15.75	22.66	1.80
Oat hay, milk and dough	47.9	45.6	2.39	3.14	15.49	24.54	2.36
Oat and pea hay	49.4	43.8	4.08	9.04	14.92	19.75	1.42
Oat and pea silage	17.2	16.1	1.07	2.49	5.36	6.67	1.21
Oat and vetch hay	48.1	44.4	3.65	5.61	12.82	23.64	2.06
Oats	62.1	60.7	1.40	8.99	3.21	44.14	4.41
Royal Oat Feed	42.6	40.4	2.14	4.63	7.41	26.34	2.72

FEEDING STUFF INSPECTION.

CHAS. D. WOODS, Director.

J. M. BARTLETT, chemist in charge of inspection analyses.

CHIEF REQUIREMENTS OF THE LAW.

The points of the law of most interest to dealer and consumer are:

Kinds of Feed coming within the Law. The law applies to *all feeding stuffs except* hays and straws; whole seeds and meals of wheat, rye, barley, oats, Indian corn, buckwheat and broom corn; wheat, buckwheat and rye brans or middlings *not mixed with other substances,* but sold separately, as distinct articles of commerce.

Inspection tax and tag. To meet the expenses of inspection, a tax of ten cents per ton must be paid to the Director of the Maine Agricultural Experiment Station, who is required to furnish a tag stating that all charges have been paid. This tag, which bears the Director's signature, shows that the tax has been paid but is *not a guarantee of the quality of the goods.*

The brand. Each package of feeding stuff included within the law shall have affixed the inspection tax tag and shall also bear, conspicuously printed: the number of net pounds contained in the package, the name or trade mark under which it is sold, the name of the manufacturer or shipper, the place of manufacture, the place of business of manufacturer or shipper, the percentage of crude protein, the percentage of crude fat. These statements may be printed directly on the bag, on a tag attached to the package, or on the back of the inspection tax tag furnished by the Director of the Station. The quality of the goods is guaranteed by the manufacturer, importer or dealer, *and not by the Station.* The samples collected and analyzed by the Station show whether the goods are up to guarantee or not.

The goods must carry the inspection tax tag and the brand before they can be legally offered for sale in the State. It will not answer to affix tags at the time the goods are sold.

MANUFACTURERS AND PLACE OF SAMPLING.

Station number.	Manufacturer or Jobber.	Manufactured at	Sampled at
9120	American Cotton Oil Co	Greenville, S. C.	Biddeford
9077	American Cotton Oil Co	Wilmington, N. C.	Newport
9090	American Cotton Oil Co	Wilmington, N. C.	Palmyra
9121	American Cotton Oil Co	Macon, Ga	Gardiner
9122	American Cotton Oil Co	Memphis, Tenn.	Newport
9123	American Cotton Oil Co	Memphis, Tenn.	Hiram
9124	American Cotton Oil Co	Jackson, Tenn.	Portland
9125	American Cotton Oil Co	Jackson, Tenn.	Bridgton
9126	American Cotton Oil Co	Jackson, Tenn.	Brunswick
9127	American Cotton Oil Co	Binkley, Ark.	Hallowell
9128	American Cotton Oil Co	Binkley, Ark.	Auburn
9129	American Cotton Oil Co	Binkley, Ark.	Camden
9130	American Cotton Oil Co	Little Rock, Ark.	Foxcroft
9131	American Cotton Oil Co	Little Rock, Ark.	Westbrook
9117	American Cotton Oil Co		Lewiston
9104	American Cotton Oil Co		Corinna
9083	R. W. Biggs & Co	Memphis, Tenn.	Athens
9105	R. W. Biggs & Co	Memphis, Tenn.	East Newport
9106	R. W. Biggs & Co	Memphis, Tenn.	East Newport
9133	R. W. Biggs & Co	Memphis, Tenn.	Waterville
9134	R. W. Biggs & Co	Memphis, Tenn.	Bangor
9135	R. W. Biggs & Co	Memphis, Tenn.	Belfast
9136	R. W. Biggs & Co	Memphis, Tenn.	Bath
9149	R. W. Biggs & Co	Memphis, Tenn.	Richmond
9151	R. W. Biggs & Co	Memphis, Tenn.	Brownfield
9140	F. W. Brodé & Co	Memphis, Tenn.	Brunswick
9141	F. W. Brodé & Co	Memphis, Tenn.	Pittsfield
9142	F. W. Brodé & Co	Memphis, Tenn.	Augusta
9143	F. W. Brodé & Co	Memphis, Tenn.	Belfast
9102	F. W. Brodé & Co	Memphis, Tenn.	North Gorham
9114	Chapin & Co	St. Louis, Mo.	East Fryeburg
9119	Chapin & Co	St. Louis, Mo.	Readfield
9144	Chapin & Co	St. Louis, Mo.	Augusta
9145	Chapin & Co	St. Louis, Mo.	Dexter
9146	Chapin & Co	St. Louis, Mo.	Bowdoinham
9147	Chapin & Co	St. Louis, Mo.	Monmouth
9148	Chapin & Co	St. Louis, Mo.	Skowhegan
9154	Chapin & Co	St. Louis, Mo.	Portland
9161	Chapin & Co	St. Louis, Mo.	Pittsfield
9162	Chapin & Co	St. Louis, Mo.	Fryeburg
9152	A. R. Hopkins & Co		South Brewer
9150	Butler, Breed Co.		Brunswick
9089	Humphreys, Goodwin & Co	Memphis, Tenn.	Palmyra
9107	Humphreys, Goodwin & Co	Memphis, Tenn.	East Newport
9137	Humphreys, Goodwin & Co	Memphis, Tenn.	Waterville
9138	Humphreys, Goodwin & Co	Memphis, Tenn.	Biddeford
9139	Humphreys, Goodwin & Co	Memphis, Tenn.	Newport
9155	Hunter Brothers.	St. Louis, Mo.	Bangor
9160	Hunter Brothers.	St. Louis, Mo.	Portland
9163	Hunter Brothers.	St. Louis, Mo.	Belfast
9132	Independent Cotton Oil Co	Memphis, Tenn.	South Paris
9153	J. E. Soper & Co		Lewiston

ANALYSES OF SAMPLES.

Name of Feed.	Protein. Found—per cent.	Protein. Guaranteed—per cent.	Fat. Found—per cent.	Fat. Guaranteed—per cent.	Station number.
Prime Cotton Seed Meal	45.69	41.50	10.18	9.00	9120
Prime Cotton Seed Meal	41.90	41.50	8.77	9.00	9077
Prime Cotton Seed Meal	43.50	41.00	9.08	9.00	9090
Prime Cotton Seed Meal	46.69	43.00	8.64	9.00	9121
Prime Cotton Seed Meal	44.69	43.00	9.55	9.00	9122
Prime Cotton Seed Meal	44.38	43.00	9.80	9.00	9123
Prime Cotton Seed Meal	46.06	43.00	9.50	9.00	9124
Prime Cotton Seed Meal	43.06	43.00	10.00	9.00	9125
Prime Cotton Seed Meal	44.25	43.00	10.42	9.00	9126
Prime Cotton Seed Meal	43.00	43.00	12.51	9.00	9127
Prime Cotton Seed Meal	44.38	43.00	11.27	9.00	9128
Prime Cotton Seed Meal	43.13	43.00	13.91	9.00	9129
Prime Cotton Seed Meal	44.25	43.00	9.86	9.00	9130
Prime Cotton Seed Meal	45.44	43.00	10.00	9.00	9131
Prime Cotton Seed Meal	45.00	43.00	10.79	9.00	9117
Prime Cotton Seed Meal	42.63	43.00	10.17	9.00	9104
"Canary" Brand Cotton Seed Meal	41.25	43.00	12.75	9.00	9083
"Canary" Brand Cotton Seed Meal	40.13	43.00	14.16	9.00	9105
"Canary" Brand Cotton Seed Meal	43.19	43.00	9.18	9.00	9106
"Canary" Brand Cotton Seed Meal	43.63	43.00	9.13	9.00	9133
"Canary" Brand Cotton Seed Meal	44.13	43.00	9.47	9.00	9134
"Canary" Brand Cotton Seed Meal	44.00	43.00	9.66	9.00	9135
"Canary" Brand Cotton Seed Meal	44.94	43.00	8.99	9.00	9136
"Canary" Brand Cotton Seed Meal	43.00	43.00	11.83	9.00	9149
"Canary" Brand Cotton Seed Meal	43.88	43.00	10.96	9.00	9151
Owl Brand Pure Cotton Seed Meal	44.38	43.00	8.76	9.00	9140
Owl Brand Pure Cotton Seed Meal	44.06	43.00	8.97	9.00	9141
Owl Brand Pure Cotton Seed Meal	45.88	43.00	9.28	9.00	9142
Owl Brand Pure Cotton Seed Meal	47.19	43.00	10.29	9.00	9143
Owl Brand Pure Cotton Seed Meal	46.88	43.00	9.65	9.00	9102
Cotton Seed Meal	41.88	43.00	9.26	9.00	9114
Cotton Seed Meal	40.63	43.00	10.53	9.00	9119
Cotton Seed Meal	46.81	43.00	8.48	9.00	9144
Cotton Seed Meal	46.81	43.00	9.57	9.00	9145
Cotton Seed Meal	44.00	43.00	8.64	9.00	9146
Cotton Seed Meal	46.50	43.00	9.74	9.00	9147
Cotton Seed Meal	46.38	43.00	9.98	9.00	9148
Cotton Seed Meal	46.19	43.00	11.11	9.00	9154
Cotton Seed Meal	44.50	43.00	9.84	9.00	9161
Cotton Seed Meal	42.06	43.00	9.18	9.00	9162
Prime Cotton Seed Meal	43.06	40.00	9.29	8.00	9152
Cotton Seed Meal	36.69	25.00	8.95	6.00	9150
"Dixie" Brand Cotton Seed Meal	43.50	43.00	11.22	9.00	9089
"Dixie" Brand Cotton Seed Meal	46.00	43.00	9.16	9.00	9107
"Dixie" Brand Cotton Seed Meal	44.88	43.00	9.52	9.00	9137
"Dixie" Brand Cotton Seed Meal	44.00	43 00	9.30	9.00	9138
"Dixie" Brand Cotton Seed Meal	45.63	43.00	10.67	9.00	9139
Prime Cotton Seed Meal	46.75	43.00	9.75	9.00	9155
Prime Cotton Seed Meal	45.63	43.00	8.67	9.00	9160
Prime Cotton Seed Meal	46.44	43.00	9.40	9.00	9163
Prime Finely Ground Cotton Seed Meal	45.69	43.00	13.75	9.00	9132
Prime Cotton Seed Meal	42.63	43.00	7.97	9.00	9153

MANUFACTURERS AND PLACE OF SAMPLING.

Station number.	Manufacturer and Jobber.	Manufactured at	Sampled at
9156	.....	.....	Auburn .....
9158	.....	.....	Readfield .....
9157	.....	.....	Dexter .....
9159	.....	.....	Bath .....
9164	.....	.....	Norway .....
9165	Glucose Sugar Refining Co	.....	Pittsfield .....
9166	Glucose Sugar Refining Co	.....	Camden .....
9167	Glucose Sugar Refining Co	.....	Bath .....
9169	Glucose Sugar Refining Co	.....	Skowhegan .....
9172	Glucose Sugar Refining Co	.....	Waterville .....
9175	Glucose Sugar Refining Co	.....	Hallowell .....
9176	Glucose Sugar Refining Co	.....	Foxcroft .....
9168	Glucose Sugar Refining Co	.....	Biddeford .....
9170	Glucose Sugar Refining Co	.....	South Brewer .....
9171	Glucose Sugar Refining Co	.....	Belfast .....
9173	Glucose Sugar Refining Co	.....	Bridgton .....
9174	Glucose Sugar Refining Co	.....	Auburn .....
9100	Glucose Sugar Refining Co	.....	North Yarmouth ...
9177	Charles Pope Glucose Co	.....	Waterville .....
9178	Charles Pope Glucose Co	.....	Gardiner .....
9179	Charles Pope Glucose Co	.....	South Paris .....
9180	Charles Pope Glucose Co	.....	Orrington .....
9181	Charles Pope Glucose Co	.....	Westbrook .....
9182	Charles Pope Glucose Co	.....	Brunswick .....
9183	National Starch Manf'g Co	Des Moines, Iowa..	Winthrop .....
9185	National Starch Manf'g Co.....	Des Moines, Iowa .	Lewiston .....
9184	National Starch Manf'g Co.....	Des Moines, Iowa .	Foxcroft .....
9186	National Starch Manf'g Co.....	Indianapolis, Ind..	Hiram .....
9187	National Starch Manf'g Co'.....	Indianapolis, Ind..	Dexter .....
9188	National Starch Manf'g Co.....	Indianapolis, Ind..	Augusta .....
9189	National Starch Manf'g Co.....	Indianapolis, Ind..	Bowdoinham .....
9190	National Starch Manf'g Co.....	Glencove, L.I., N.Y.	Saco .....
9071	Archer Starch Co	Bradley, Ill.....	South Berwick.....
9191	Glucose Sugar Refining Co	.....	Biddeford .....
9192	Glucose Sugar Refining Co	.....	Belfast.....
9196	Glucose Sugar Refining Co . ..	.....	Waterville.....
9193	Glucose Sugar Refining Co	.....	Skowhegan .....
9193	Glucose Sugar Refining Co	.....	Camden .....
9194	Glucose Sugar Refining Co	.....	Brunswick .....
9195	Glucose Sugar Refining Co	.....	Foxcroft .....
9197	Glucose Sugar Refining Co	.....	Waterville .....
9199	Cleveland Linseed Oil Co.....	.....	Skowhegan .....
9200	Cleveland Linseed Oil Co.....	.....	Rockland.....
9201	American Linseed Co.	Chicago, Ill	Brunswick .....
9202	.....	.....	Augusta.....
9203	.....	.....	Augusta.....
9205	.....	.....	Richmond .....
9204	American Milling Co	Chicago, Ill	Auburn .....
9206	E. W. Blatchford & Co	.....	Corinna .....
9207	E. W. Blatchford & Co	.....	Brunswick .....
9208	W. H. Haskell & Co.....	Toledo, Ohio.	Portland .....
9209	The Riverside Rolled Oats Co..	Riverside, Iowa ...	Bath .....

ANALYSES OF SAMPLES.

Name of feed.	Protein.		Fat.		Station number.
	Found—per cent.	Guaranteed—per cent.	Found—per cent.	Guaranteed—per cent.	
Cotton Seed Meal	46.13	43.00	96.40	9.00	9156
Cotton Seed Meal	46.44	43.00	10.29	9.00	9158
Cotton Seed Meal	47.75	46.12	9.98	9.20	9157
Cotton Seed Meal	46.19	46.12	10.29	9.20	9159
Cotton Seed Meal	47.44	46.12	9.56	9.20	9164
Chicago Gluten Meal	37.81	38.00	3.12	2.00	9165
Chicago Gluten Meal	35.19	38.00	2.56	2.00	9166
Chicago Gluten Meal	37.88	38.00	3.15	3.00	9167
Chicago Gluten Meal	40.56	38.00	3.86	2.00	9169
Chicago Gluten Meal	38.50	38.00	2.72	3.00	9172
Chicago Gluten Meal	39.44	38.00	3.20	3.00	9175
Chicago Gluten Meal	38.75	38.00	3.35	3.37	9176
Chicago Gluten Meal	35.56	39.50	3.06	3.37	9168
Chicago Gluten Meal	40.13	39.50	2.88	3.37	9170
Chicago Gluten Meal	39.44	39.50	3.31	3.37	9171
Chicago Gluten Meal	39.81	39.50	2.97	3.37	9173
Chicago Gluten Meal	36.06	39.50	2.70	3.37	9174
Chicago Gluten Meal	40.38	.....	4.41	.....	9100
Cream Gluten Meal	38.69	34.12	2.11	3.20	9177
Cream Gluten Meal	40.13	34.12	3.27	3.20	9178
Cream Gluten Meal	36.63	34.12	3.29	3.20	9179
Cream Gluten Meal	34.81	34.12	3.33	3.20	9180
Cream Gluten Meal	35.31	34.12	3.73	3.20	9181
Cream Gluten Meal	43.81	34.12	1.34	3.20	9182
King Gluten Meal	37.31	32.40	2.45	3.70	9183
King Gluten Meal	39.19	32.40	2.42	3.70	9185
King Gluten Meal	37.63	32.00	2.60	16.00	9184
King Gluten Meal	36.69	33.13	5.34	4.82	9186
King Gluten Meal	32.56	32.70	5.11	4.50	9187
King Gluten Meal	36.88	32.70	3.97	4.50	9188
King Gluten Meal	34.44	32.70	3.88	4.50	9189
Gluten Feed	27.69	28.40	3.65	4.30	9190
Gluten Feed	17.44	.....	3.21	.....	9071
Germ Oil Meal	22.06	25.50	13.99	10.50	9191
Germ Oil Meal	23.88	25.50	10.95	10.50	9192
Germ Oil Meal	23.50	25.50	13.05	10.50	9196
Germ Oil Meal	22.69	25.50	13.64	10.50	9198
Germ Oil Meal	24.50	25.00	9.03	3.00	9193
Germ Oil Meal	23.94	25.00	10.23	3.00	9194
Germ Oil Meal	21.25	25.00	12.25	3.00	9195
Germ Oil Meal	21.69	25.00	9.98	3.00	9197
Linseed Oil Meal	38.25	39.00	2.38	1.50	9199
Cleveland Flax Meal	39.25	39.00	2.81	1.50	9200
Old Process Oil Meal	31.94	32.00	7.71	5.00	9201
Old Process Oil Meal	33.38	.....	6.70	.....	9202
Linseed Oil Meal	37.56	38.00	2.31	1.00	9203
Linseed Oil Meal	38.44	38.00	2.56	1.00	9205
Sucrene Oil Meal	26.50	25.00	6.92	3.50	9204
Blatchford's Calf Meal	25.06	32.00	5.20	5.00	9206
Blatchford's Calf Meal	25.56	32.00	5.23	5.00	9207
Oat Feed	11.81	9.62	9.46	7.66	9208
Puritan Oat Feed	13.81	.....	6.04	.....	9209

MANUFACTURERS AND PLACE OF SAMPLING.

Station number.	Manufacturer or Jobber.	Manufactured at	Sampled at
9210	American Cereal Co	Chicago, Ill	Westbrook
9211	American Cereal Co.	Chicago, Ill.	Rockland
9212	American Cereal Co.	Chicago, Ill.	Augusta
9213	American Cereal Co.	Chicago, Ill.	Foxcroft
9214	American Cereal Co.	Chicago, Ill.	Brunswick
9215	American Cereal Co.	Chicago, Ill.	Skowhegan
9216	American Cereal Co.	Chicago, Ill.	Hiram
9217	American Cereal Co.	Chicago, Ill.	Lewiston
9055	American Cereal Co.	Chicago, Ill.	Waldoboro
9218	American Cereal Co.	Chicago, Ill.	Bath
9219	American Cereal Co.	Chicago, Ill.	Hiram
9220	American Cereal Co.	Chicago, Ill.	Brunswick
9221	American Cereal Co.	Chicago, Ill.	Augusta
9222	American Cereal Co.	Chicago, Ill.	Belfast
9223	American Cereal Co.	Chicago, Ill.	Skowhegan
9224			Foxcroft
9225	O. Holway Co	Auburn	Waterville
9226	Husted Milling & Elevator Co.	Buffalo, N. Y	Brownfield
9227	Hunter Bros	St. Louis, Mo.	Auburn
9228	Hunter Bros.	St. Louis, Mo.	Winthrop
9229			Dexter
9292			Castle Hill
9239			Monmouth
9233	American Cereal Co.	Chicago, Ill.	Richmond
9230	Muscatine Oat Meal Co	Muscatine, Iowa	Biddeford
9231	Muscatine Oat Meal Co.	Muscatine, Iowa	Westbrook
9232	Muscatine Oat Meal Co	Muscatine, Iowa	Rockland
9234	The H-O Company	Buffalo, N. N	Freeport
9235	The H-O Company	Buffalo, N. Y	Freeport
9236	The American Cereal Co.	Chicago, Ill.	Westbrook
9237	The American Cereal Co.	Chicago, Ill.	Brunswick
9238	M. L. Crittenden.	Buffalo, N. Y	Portland
9240	The Bowker Co	Boston, Mass.	Freeport
9241	The Bowker Co	Boston, Mass.	Gardiner
9242	The Bowker Co	Boston, Mass.	Brunswick
9243	The Bowker Co	Boston, Mass.	Camden
9244	The Bowker Co	Boston, Mass.	Brunswick
9245	The Bowker Co	Boston, Mass.	Richmond
9246	The Bowker Co	Boston, Mass.	Freeport
9247	The Bradley Fertilizer Co.	Boston, Mass.	Portland
9248			Portland
9249	Armour Fertilizer Works.	Chicago, Ill.	Portland
9251	Henderson Milling Co.	Henderson, Ky	Fryeburg
9252			Brunswick
9253	Kentucky Milling Co	Henderson, Ky	Bowdoinham
9254	Kentucky Milling Co	Henderson, Ky	Corinna
9250	American Cereal Co.	Chicago, Ill.	Camden

ANALYSES OF SAMPLES.

Name of feed.	Protein.		Fat.		Station number.
	Found—per cent.	Guaranteed—per cent.	Found—per cent.	Guaranteed—per cent.	
Vim Oat Feed	7.13	6.50	2.90	2.50	9210
Quaker Dairy Feed	12.56	12.03	3.36	2.50	9211
Quaker Dairy Feed	13.13	12.03	3.28	2.50	9212
Quaker Dairy Feed	12.63	12.03	3.07	2.50	9213
Quaker Dairy Feed	13.69	12.03	3.26	2.50	9214
Quaker Dairy Feed	11.31	12.03	2.68	2.50	9215
Quaker Dairy Feed	14.31	12.03	3.73	2.50	9216
Quaker Dairy Feed	12.13	12.03	2.97	2.50	9217
Quaker Oat Feed	11.25	12.03	4.57	2.50	9055
Victor Corn and Oat Feed	9.25	8.23	3.23	3.00	9218
Victor Corn and Oat Feed	10.13	8.23	4.89	3.00	9219
Victor Corn and Oat Feed	9.69	8.23	4.33	3.00	9220
Victor Corn and Oat Feed	9.31	8.23	3.30	3.00	9221
Victor Corn and Oat Feed	9.00	8.23	4.00	3.00	9222
Victor Corn and Oat Feed	9.31	8.23	3.26	3.00	9223
Monarch Corn and Oat Feed	10.50	.....	6.45	.....	9224
Monarch Corn and Oat Feed	11.06	10.25	8.04	7.47	9225
Monarch Chop Feed	8.56	9.19	3.72	3.45	9226
Ned Chops	11.25	.....	6.24	.....	9227
Ned Chops	10.94	10.25	7.17	7.47	9228
Corn and Oat Feed	11.88	.....	3.34	.....	9229
Corn and Oat Feed	9.63	10.81	3.89	6.02	9292
Corn and Oat Chop	10.00	.....	5.50	.....	9239
Shumacher's Stock Feed or Corn, Oats and Barley	12.13	10.79	4.98	3.28	9233
Friend's Concentrated Dairy Food	8.13	10.70	7.15	3.70	9230
Friend's Concentrated Dairy Food	8.75	.....	3.39	.....	9231
Friend's Concentrated Dairy Food	8.13	10.70	3.28	3.70	9232
The H-O Co.'s Dairy Feed	17.88	18.00	3.84	4.50	9234
The H-O Co.'s Horse Feed	13.44	12.00	4.66	4.50	9235
American Poultry Food	13.63	13.96	6.74	5.48	9236
American Poultry Food	13.51	13.96	6.80	5.48	9237
Sterling Provender	8.75	8.82	3.81	5.55	9238
Bowker's Animal Meal	36.13	30.00	10.37	5.00	9240
Bowker's Animal Meal	39.06	30.00	8.49	5.00	9241
Bowker's Animal Meal	38.31	30.00	8.79	5.00	9242
Bowker's Animal Meal	41.00	30.00	8.29	5.00	9243
Bowker's Ground Beef Scraps	52.06	.....	18.15	.....	9244
Bowker's Ground Beef Scraps	49.19	30.00	15.40	20.00	9245
Bowker's Ground Beef Scraps	54.25	30.00	19.42	20.00	9246
Bradley's Superior Meat Meal	51.69	40.00	9.48	8.00	9247
Ground Beef Scraps for Poultry	66.81	50.00	13.10	9.00	9248
Meat Meal	63.19	60.00	15.23	13.00	9249
Kentucky Mixed Feed	13.75	12.00	3.79	3.00	9251
Purity Mixed Feed	13.88	.....	4.12	.....	9252
Jersey Mixed Feed	12.63	11.50	3.83	3.50	9253
Jersey Mixed Feed	14.63	.....	4.03	.....	9254
Buckeye Wheat Feed	18.94	16.21	4.76	4.48	9250

SUMMARY OF ANALYSES.

	Number of analyses.		Protein. Found—per cent.	Protein. Guaranteed—per cent.	Fat.* Found—per cent.	Fat.* Guaranteed—per cent.
American Cotton Oil Co.'s Prime Cotton Seed Meal.	16	Highest	46.69	.....	13.91	
		Lowest	42.63	*43.00	8.64	9.00
		Average	44.25	.....	10.25	
R. W. Biggs & Co.'s "Canary" Brand Cotton Seed Meal.	9	Highest	44.94	.....	14.16	
		Lowest	40.13	43.00	8.29	9.00
		Average	43.13	.....	10.68	
F. W. Brodé & Co.'s Owl Brand Cotton Seed Meal.	5	Highest	47.19	.....	10.29	
		Lowest	44.06	43.00	8.76	9.00
		Average	45.68	.....	9.39	
Chapin & Co.'s Cotton Seed Meal.	10	Highest	46.81	.....	11.11	
		Lowest	40.63	43.00	8.48	9.00
		Average	44.58	.....	9.63	
A. R. Hopkins & Co.'s Prime Cotton Seed Meal.	1	.....	43.06	40.00	9.29	5.00
Butler, Breed Co.'s Cotton Seed Meal.	1	.....	36.69	25.00	8.95	6.00
Humphreys, Goodwin & Co.'s "Dixie" Brand Cotton Seed Meal.	5	Highest	46.00	.....	11.22	
		Lowest	43.50	43.00	9.16	9.00
		Average	44.80	.....	9.97	
Hunter Brother's Prime Cotton Seed Meal.	3	Highest	46.75	.....	9.75	
		Lowest	45.63	43.00	8.67	9.00
		Average	46.27	.....	9.27	
Independent Cotton Oil Co.'s Prime Finely Ground Cotton Seed Meal.	1	.....	45.69	43.00	13.75	9.00
J. E. Soper & Co.'s Prime Cotton Seed Meal.	1	.....	42.63	43.00	7.97	9.00
Manufacturers unknown Cotton Seed Meal.	2	Highest	46.44	.....	10.29	
		Lowest	46.13	43.00	9.64	9.00
		Average	46.29	.....	9.27	
Manufacturers unknown Cotton Seed Meal.	3	Highest	47.75	.....	10.29	
		Lowest	46.19	46.12	9.56	9.20
		Average	47.13	.....	9.93	
Summary of all high grade cotton seed meals analyzed.	56	Highest	47.75	46.10	14.16	
		Lowest	‡40.13	41.00	.....	
		Average	44.62	.....	10.05	
Low grade cotton seed meal.	1	.....	36.69	25.00	8.95	6.00
Glucose Sugar Refining Co.'s Chicago Gluten Meal.	13	Highest	40.56	39.50	4.41	3.37
		Lowest	35.19	38.00	2.70	3.00
		Average	38.44	36.00	3.14	2.00
Charles Pope Glucose Co.'s Cream Gluten Meal.	6	Highest	43.81	.....	3.73	
		Lowest	34.81	34.12	1.34	3.20
		Average	38.23	.....	2.84	

* One sample guaranteed 41.50 carried 41.90 per cent of protein.

‡ One sample only guaranteed to carry 25 per cent of protein had 36.69 per cent protein.

SUMMARY OF ANALYSES—CONTINUED.

	Number of analyses.		Protein.		Fat.	
			Found—per cent.	Guaranteed—per cent.	Found—per cent.	Guaranteed—per cent.
National Starch Manf'g Co.'s King Gluten Meal.	7	Highest	39.19	32.40	5.34	3.07
		Lowest	32.56	32.00	2.42	16.00
		Average	36.39	33.13	3.68	4.82
				32.70		4.05
National Starch Manf'g Co.'s Gluten Feed.	1	.....	27.69	28.40	3.65	4.30
The Archer Starch Co.'s Gluten Feed.	1	.....	17.44	.....	3.21	
Glucose Sugar Refining Co.'s Germ Oil Meal.	8	Highest	24.50	25.50	13.99	10.50
		Lowest	21.25	25.00	9.03	3.00
		Average	22.94	.....	10.39	
The Cleveland Linseed Oil Co.'s Linseed Oil Meal.	1	... .	38.25	39.00	2.38	1.50
The Cleveland Linseed Oil Co.'s Cleveland Flaxmeal.	1	....	39.25	39.00	2.81	1.50
American Linseed Co.'s Old Process Oil Meal.	1	.....	31.94	32.00	7.71	5.00
American Milling Co.'s Sucrene Oil Meal.	1	.....	26.50	25.00	6.92	3.50
E. W. Blatchford & Co.'s Blatchford's Calf Meal.	2	Highest	25.56	.....	5.23	
		Lowest	25.06	32.00	5.20	5.00
		Average	25.31	.....	5.22	
W. H. Haskell & Co's Oat Feed.	1	....	11.81	9.62	9.46	7.66
Riverside Rolled Oats Co.'s Puritan Oat Feed.	1	.....	13.81	.....	6.04	
American Cereal Co.'s Vim Oat Feed.	1	....	7.13	6.50	2.90	2.50
American Cereal Co.'s Quaker Dairy Feed.	7	Highest	14.31	....	3.73	
		Lowest	11.31	12.03	2.68	2.50
		Average	12.82	.....	3.19	
American Cereal Co.'s Quaker Oat Feed.	1	... .	11.25	12.03	4.57	2.50
American Cereal Co.'s Victor Corn and Oat Feed.	6	Highest	10.13	.....	4.89	
		Lowest	9.00	8.23	3.23	3.00
		Average	9.45	....	3.84	
O. Holway Co.'s Monarch Corn and Oat Feed.	2	Highest	11.06	.....	8.04	
		Lowest	10.50	10.25	6.45	7.47
		Average	10.78	.....	7.25	
Husted Milling & Elevator Co.'s Monarch Chop Feed.	1	.....	8.56	9.19	3.72	3.45
Hunter Brothers' Ned Chops.	2	Highest	11.25	.....	7.17	
		Lowest	10.94	10.25	6.24	7.47
		Average	11.10	... .	6.71	
American Cereal Co.'s Schumacher's Stock Feed or Corn, Oats and Barley.	1	....	12.13	10.79	4.98	3.28

SUMMARY OF ANALYSES—CONCLUDED.

	Number of analyses.		Protein.		Fat.	
			Found—per cent.	Guaranteed—per cent.	Found—per cent.	Guaranteed—per cent.
The Muscatine Oat Meal Co 's Friend's Conc'nt'd Dairy Food	3	Highest	8.75	.....	7.15	
		Lowest	8.13	10.70	3.28	3.77
		Average	8.34	.....	4.61	
The H-O Company's Dairy Feed.	1	.....	17.88	18.00	3.84	4.50
The H-O Company's Horse Feed.	1	.....	13.44	12.00	4.66	4.50
American Cereal Co.'s American Poultry Food.	2	Highest	13.81	.....	6.80	
		Lowest	13.63	13.96	6.74	5.48
		Average	13.72	.....	6.77	
M. L. Crittenden's Sterling Provender.	1	.....	8.75	8.82	3.81	5.55
The Bowker Co.'s Bowker's Animal Meal.	4	Highest	41.00	.....	10.37	
		Lowest	36.13	30.00	8.29	5.00
		Average	38.63	.....	8.99	
The Bowker Co.'s Bowker's Ground Beef Scraps	3	Highest	54.25	.....	18.15	
		Lowest	49.19	30.00	15.40	20.00
		Average	51.83	.....	17.66	
The Bradley Fertilizer Co.'s Bradley's Superior Meat Meal	1	....	51.69	40.00	9.48	8.00
Manufacturer's unknown Ground Beef Scraps for Poult.	1	.. ..	66.81	50.00	13.10	9.00
Armour Fertilizer Works Meat Meal.	1	.....	63.19	60.00	15.23	13.00
Henderson Milling Co.'s Kentucky Mixed Feed.	1	....	13.75	12.00	3.79	3.00
Manufacturers unknown Purity Mixed Feed.	1	.....	13.88	.....	4.12	
Kentucky Milling Co.'s Jersey Mixed Feed.	2	Highest	14.63	.....	4.08	
		Lowest	12.63	11.50	3.83	3.50
		Average	13.63	.....	3.93	
American Cereal Co.'s Buckeye Wheat Feed.	1	....	18.94	16.21	4.76	4.48

ANALYSES OF BRANS AND MIXED FEEDS COLLECTED IN 1900.

Station number.	Manufacturer or dealer.	Sampled at	Name of Feed.	Protein—per cent.
9255	Acme Milling Co	Augusta	Acme Mixed Feed	17.56
9256	Alma Roller Mills	Freeport	Straight Alma Mixed Feed	16.69
9257	Austed & Burke	Dexter	Mixed Feed	17.25
9258	Berger, Anderson & Co	Saco	Badger Mixed Feed	18.56
9259	Blish Milling Co	Foxcroft	Winter Wheat Mixed Feed	18.13
9263	Chapin & Co	Skowhegan	Mixed Feed	15.63
9260	Doten Grain Co	Portland	Royal Mixed Feed	17.38
9261	Hunter Bros	South Brewer	Hunter Bros.' Mixed Feed.	17.75
9262	J. Jencks	Skowhegan	Winter Wheat Mixed Feed.	15.56
9264	Lawrenceburg Roller Mills Co	South Brewer	Snow Flake Mixed Feed	17.88
9265	R. P. Moore Milling Co	Brunswick	King Feed, Pure Bran and Middlings	18.25
9078	Portland Milling Co	Newport	Champion Mixed Feed	15.25
9088	Portland Milling Co	Newport	Champion Mixed Feed	16.94
9266	Portland Milling Co	Waterville	Champion Mixed Feed	16.31
9267	Rex Milling Co	Bowdoinham	Mixed Feed	17.56
9268	The Shelby Mill Co	Bath	Mixed Feed	17.88
9269	F. W. Stock	Norway	M. F. Mixed Feed	16.88
9270	David Stott	Waterville	Stott's Mixed Feed	16.50
9271	Valley City Milling Co	Richmond	Farmers Favorite Mixed Winter Wheat Cow Feed.	17.44
9272	Valley City Milling Co	Waterville	Farmers Favorite Mixed Winter Wheat Cow Feed.	16.25
9273	Zenith Milling Co	Bowdoinham	Mixed Feed	17.81
9274	L. P. Snow	Brunswick	Mixed Feed	16.25
9275	Hunter, MacMaster Co	Pittsfield	Mixed Feed	13.50
9276	L. N. Littlehale	Rockland	Faist's Mixed Feed	18.19
9277	H. C. Morse	Waterville	Mixed Feed	16.56
9070	C. B. Cummings & Son	Norway	Mixed Feed	12.56
9074	C. A. S. Holland	Portland	Mixed Feed	16.06
9081		Kennebunk	Kansas Feed	18.56
9084	Steward Bros	Skowhegan	Fancy Mixed Feed	15.06
9108	Judkins & Gilman	East Newport	Ground Wheat Feed	18.25
9278	Austed & Burke	Camden	Bran Best Flour Wm. Tell Bob White Golden Fleece	16.31
9279	W. A. Coomb's Mills	Dexter	Winter Wheat Bran	16.38
9280	Schultz, B. & Co	Foxcroft	Bran	15.81
9086	David Stott	Newport	Stott's Pure Winter Wheat Bran	15.81
9109	David Stott	East Newport	Stott's Pure Winter Wheat Bran	15.13
9281	David Stott	Foxcroft	Stott's Pure Winter Wheat Bran	15.94
9282	Valley City Milling Co	Skowhegan	Michigan Winter Wheat Bran	17.56
9283	Voigt Milling Co	Skowhegan	Voigt's Choice Winter Wheat Bran	17.00
9284	E. S. Woodworth Co	Norway	Snow's Flaky Bran	16.94
9285	Pillsbury's Mill	Foxcroft	Pillsbury's Bran	16.31
9286	R. H. Soule & Co	South Windham	Ballard's Bran	16.94
9079		Newport	Bran	15.81
9087	J. F. Longley	Newport	Bran	16.81
9103	Washburn Crosby	North Gorham	Bran	16.13
9111	F. W. Stock	Corinna	Bran	15.69
9287	Washburn Crosby Co	Augusta	Standard Middlings	19.13

COTTONSEED MEAL.

Pure cottonseed meal is made by grinding the seed after the white down, which remains upon the seed as it comes from the cotton gin, and the hard hulls have been removed. Thus prepared, cottonseed meal may carry from 40 to 53 per cent of protein. The analyses of 57 samples are reported. The guarantees for the high grade cottonseed meal varied from 41 per cent of protein and 9 per cent of fat to 46.12 per cent protein and 9.2 per cent fat. The lowest protein found was 40.13 per cent and the lowest fat 7.97 per cent. The averages are considerably above the guaranteed percentages.

Only 6 of the 57 samples were below guarantee in protein. One sample was nearly 3 per cent below in protein but the fat was 5 per cent above the guarantee, thus indicating that the falling off in protein was due to the imperfect removal of the fat and not to poor seed or the addition of adulterants. The other 5 samples fell less than 2 per cent below the guaranteed protein.

Only one sample of low grade cottonseed meal was found by the inspector and none have been received from correspondents. At the first inspection under the law (December, 1897) 12 samples of low grade unguaranteed cottonseed meals carrying from 20 to 30 per cent of protein were found. If the law regulating the sale of concentrated commercial feeding stuffs has accomplished nothing else, this driving low grade cottonseed meal out of the Maine market is worth to the agriculture of the State more than the cost of inspection.

GLUTEN MEALS AND FEEDS.

Gluten meals and gluten feeds are by-products left in the manufacture of starch and glucose from Indian corn. Corn consists largely of starch. The waste product from the manufacture of starch or sugar is relatively much richer in oil and protein than corn. Most factories are removing part of the corn oil from the waste, so that nearly all the gluten meals carry but little oil, e. g., Chicago Gluten Meal, which two years ago carried 7 to 9 per cent of fat, now has from 2.50 to 4 per cent. This reduction in fat is probably an advantage, as feeding corn oil to dairy animals seems to have a tendency to make softer butter.

Chicago Gluten Meal was as in the past found at many places. Three different guarantees were found on the different lots, ranging from 36 to 39.5 per cent in protein and from 2 to 3.37 per cent in fat. The more common guarantee is that given by the State agents—protein 38 per cent and fat 2 per cent. The average of the 13 samples examined was protein 38.44 per cent and fat 3.14 per cent.

Cream Gluten, made by the Chas. Pope Glucose Co., carries the same guarantee as in the past, 34.12 per cent protein and 3.20 per cent fat. They have evidently changed the process of manufacture, for the goods are much improved in protein content. Eleven samples taken in December, 1899, carried from 30.31 to 34.94 per cent protein, with an average of 32.99 per cent. Six samples collected in December, 1900, carry 34.81 per cent (almost the same as the highest in 1899) to 43.81 and the 6 samples taken in December, 1900, average 38.23 per cent, or over 5 per cent more protein than in 1899. The fat content remains practically unchanged. In composition the goods very closely resemble Chicago Gluten Meal.

A year ago part of the King Gluten Meal carried nearly 16 per cent of fat. The King Gluten Meal now found in the State has a fat content ranging from 2.42 per cent to 5.34 with an average of 3.68 per cent. None of the goods correspond in fat to the original guarantee (16 per cent) found on occasional lots. The goods carry on the average (7 samples) 36.39 per cent protein and 3.68 per cent fat, rather more fat and 2 per cent less protein than either Chicago or Cream Gluten.

Very little gluten feed is used in the State. The Natural Starch Manufacturing Company's gluten feed (1 sample) agrees fairly well with the guarantees. One unguaranteed lot of very poor gluten feed, made by the Auburn Starch Company of Bradley, Ill., was found at Brewer. Very little of this brand has been sold.

Germ Oil Cake, a corn product, is quite generally distributed in the State. It is sold at a somewhat less price than gluten meal. In no case does it come up to the guaranteed protein. On the average the 8 samples carried 2 per cent less protein than the more common guarantee of 25 per cent. As a source of protein it is about as good as rather poor gluten feed and has

less than two-thirds the value of good gluten meal. Only one sample of Sucrene oil meal was found. It carried more of protein and fat than called for by the guarantees. In composition it resembles a good gluten feed.

OAT FEEDS. CORN CHOPS.

The various oat feeds, corn chops and corn and oat feeds are still used in the State to a large extent. Some of these are the straight refuse from the manufacture of oat meal and others like the H-O Company's goods are mixtures of such refuse with other by-products of higher protein content. They are all well up to their respective guarantees and no fault can be found with the manufacturers for their desire to sell these goods, as they are making no claims for nutrients which the goods do not contain. The intelligent buyer of feeding stuffs, who has his barns well filled with hay, corn fodder and silage, will have very little use for these feeds low in protein content.

The value of by-products of the oat as cattle foods has been discussed in bulletin 70 of this Station.

ADULTERATED BRANS. MIXED FEEDS.

Bulletin 63 published in April, 1900, contained the following:

"In the fall of 1899 the Station began to receive from correspondents samples of goods that were bought for bran, but were of very low grade, carrying from 9 to 12 per cent protein, instead of the 15 to 17 per cent that good bran ought to carry. Investigation brought out the fact that certain mills in Kentucky and Tennessee and perhaps in other sections as well were adulterating bran by grinding and mixing with it such materials as corn cobs, the waste from corn broom factories and the like."

These goods are still being sold in the State (one concern having bought tax tags for 1,500 tons since March, 1900), but they are sold under the law and the purchaser knows from the guarantee what the goods are. These so-called mixed feeds carry more protein and fat than the guarantees call for. If the users of these foods are not getting a fair value for their money, they alone are at fault. The law is doing in this instance exactly what it was intended to do. It does not prohibit the sale of such goods but makes it so that they must be offered on their merits.

WHEAT BRAN AND MIDDLINGS—MIXED FEED.

The refuse products in the milling of wheat are very important cattle foods. With the exception of Indian corn, whole and ground, there is probably no other class of foods used so largely in this State as food for dairy stock. "Wheat, rye and buckwheat brans or middlings, not mixed with other substances, but sold separately, as distinct articles of commerce" are, under the law, exempt from inspection. In order that the character of these feeds might be investigated, soon after the law went into effect the Station analyzed a large number of the wheat offals which were being sold in the State. As this class of feeds are, in addition to their mineral matters, of chief importance as a source of nitrogen, only the protein was determined in them. All suspicious samples were examined under the microscope, but in no instance was foreign matter found that indicated adulteration. In a few cases oat and barley hulls were observed but in no greater amount than sometimes occurs in wheat.

As the result of this study and after consultation with the Secretary of the Board of Agriculture it was decided that the spirit of the law would not be broken if all wheat offals should be considered as exempt from its requirements, even though they might be called mixed feeds.

As noted elsewhere in this bulletin, in the fall of 1899 it was found by samples sent from correspondents that advantage was being taken of this exemption and that wheat brans adulterated with worthless foreign materials were being sold under the general name of mixed feeds and that one company had even the face to call such a mixture "purity" mixed feed. Because of this discovery the inspector was instructed to collect samples of brans, etc., paying particular attention to goods of suspicious appearance. As a result 24 samples were found of these low grade goods. The results were printed in bulletin 63 of this Station.

After consultation with the Secretary of the Board of Agriculture (who is by law the prosecuting officer of violations of the feeding stuffs law), it was decided to reverse the earlier decision and bulletin 63 contained the following statement:

"In view of the fact that these adulterations make it necessary for the Station to examine all mixed feeds in order to see

whether they are straight wheat offals or not, it has been decided that from this time on the strict letter of the law will be observed, and that the only concentrated feeds which will not be subject to the requirements are the meals made from pure grains, and wheat, rye and buckwheat brans or middlings. All mixed feeds, even though they are the straight refuse from the milling of wheat, will be hereafter included in the requirements."

The large dealers in the State said that they believed that the publicity which had been given to these fraudulent goods would result in their not being sold except under the provisions of the law. They also explained that the goods labelled mixed feed by some mills were identical with those called brans by others, that it would be difficult to get these mills to change their labelling and that the strict enforcement of the letter of the law would result in a discrimination against perfectly reliable goods carrying the name mixed feed. As a result it was decided to wait and see what the outcome would be and no attempt was made to see that the later ruling was complied with.

When the inspector made his rounds in December, 1900, he was instructed to draw samples of brans and mixed feeds. As a result 46 samples were collected and analyzed. These goods were surprisingly high in protein. The lowest of them was labelled "bran" and had the appearance of being unadulterated. The two low samples of mixed feed were also probably straight goods.

The value of the inspection is strikingly shown in that only 3 at all suspicious samples were found in December, 1900, when a year earlier 24 samples of low grade goods were obtained.

For the reasons above stated and because of the freedom of this class of goods at present from adulterations, the Station will continue to treat the straight products from the milling of wheat as not coming under the requirements of the law. Brans, mixed feeds and more especially middlings vary greatly in feeding value. Large users will always find it to their advantage to send samples of these goods to the Station for analysis. This analysis will be made free of charge and the results promptly returned.

FERTILIZER INSPECTION.

CHAS. D. WOODS, Director.
J. M. BARTLETT, Chemist in Charge of Fertilizer Analysis.

The law regulating the sale of commercial fertilizers in this State calls for two bulletins each year. The first of these contains the analyses of the samples received from the manufacturer, guaranteed to represent, within reasonable limits, the goods to be placed upon the market later. The second bulletin contains the analyses of the samples collected in the open market by a representative of the Station.

The figures which are given as the percentages of valuable ingredients guaranteed by the manufacturers are the minimum percentages of the guarantee. If, for instance, the guarantee is 2 to 3 per cent of nitrogen, it is evident that the dealer cannot be held to have agreed to furnish more than 2 per cent and so this percentage is taken as actual guarantee. The figures under the head of "found" are those showing the actual composition of the samples.

In 1894 this Station stopped printing trade valuations. The chief reason for so doing was that *commercial* values are not the same as *agricultural* values. Trade values are determined by market conditions, the agricultural value is measured by the increase of crop. Printing trade valuations increases the tendency, already far too strong, to purchase fertilizers on the *ton* basis without regard to the content or form of plant food. The agricultural value of a fertilizer depends upon the amount and form of nitrogen, phosphoric acid and potash it contains and the use to which it is to be put. The purchase of a fertilizer is really the purchase of one or more of these ingredients, and the thing of first importance is not the trade value of a ton, but the kinds and pounds of plant food contained in a ton.

DESCRIPTIVE LIST OF MANUFACTURERS' SAMPLES, 1901.

Station number.	Manufacturer, place of business and brand.
	THE AMERICAN AGRICULTURAL CHEM. CO., NEW YORK, N. Y.
2112	Bradley's Complete Manure for Potatoes and Vegetables
2321	Bradley's Corn Phosphate
2111	Bradley's Eureka Fertilizer
2322	Bradley's Niagara Phosphate
2323	Bradley's Potato Fertilizer
2324	Bradley's Potato Manure
2325	Bradley's X. L. Superphosphate
2326	Clark's Cove Bay State Fertilizer
2327	Clark's Cove Bay State Fertilizer, G. G
2330	Clark's Cove Defiance Complete Manure
2565	Clark's Cove Great Planet Manure
2328	Clark's Cove King Philip Alkaline Guano
1219	Clark's Cove Seeding Down Fertilizer
1607	Cleveland Fertilizer for All Crops
2619	Cleveland High Grade Complete Manure
2329	Cleveland Potato Phosphate
2106	Cleveland Seeding Down Fertilizer
2330	Cleveland Superphosphate
2331	Crocker's "Corn Phosphate"
2332	Crocker's Grass and Oats Fertilizer
2333	Crocker's New Rival Ammoniated Superphosphate
2566	Crocker's Potato, Hop and Tobacco
2335	Crocker's "Superior" Fertilizer
2567	Cumberland Guano
2336	Cumberland Potato Fertilizer
1395	Cumberland Seeding Down Manure
2337	Cumberland Superphosphate
2377	Darling's Blood, Bone and Potash
1230	Great Eastern "General Fertilizer"
1231	Great Eastern "Grass and Oats Fertilizer"
2385	Great Eastern "High Grade" "Special Potato Manure"
2384	Great Eastern "Northern Corn Special"
2568	Great Eastern "Potato Manure"
2369	Otis Potato Fertilizer
2380	Otis Seeding Down Fertilizer
2368	Otis Superphosphate
2338	Pacific Grass and Grain Fertilizer
2569	Pacific High Grade General Fertilizer
2339	Pacific Nobsque Guano
2340	Pacific Potato Special
2341	Soluble Pacific Guano
2570	Soluble Pacific Guano with 10% Potash
2342	Packer's Union "Animal Corn Fertilizer"
2343	Packer's Union "Economical Vegetable Guano"
2571	Packer's Union Gardeners Complete Manure

ANALYSES OF MANUFACTURERS' SAMPLES, 1901.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
			Total.					Available.		Total.			
	Soluble in water.	Insoluble in water.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	%	%	%	%	%	%	%	%	%	%	%	%	%
2112	1.06	2.40	3.46	3.30	5.36	3.32	1.51	8.68	8.00	10.19	9.00	6.91	7.00
2321	0.66	1.42	2.08	2.50	7.05	2.55	2.56	9.60	8.00	12.16	10.00	2.01	1.50
2111	0.11	1.06	1.17	1.25	5.93	2.35	1.55	8.28	8.00	9.83	9.00	2.32	2.00
2322	0.40	0.64	1.04	1.00	5.41	3.15	1.38	8.56	7.00	9.94	8.00	1.49	1.08
2323	0.77	1.22	1.99	2.50	5.74	4.74	2.54	10.48	8.00	13.02	10.00	3.17	3.00
2324	0.81	1.58	2.39	3.00	2.89	3.80	3.18	6.69	6.00	9.87	8.00	5.15	5.00
2325	1.10	1.36	2.46	3.00	6.74	3.16	1.80	9.90	9.00	11.70	11.00	2.68	2.00
2326	1.14	1.32	2.46	2.47	7.26	3.08	1.80	10.34	9.00	12.14	10.00	2.35	2.00
2327	0.62	1.40	2.02	2.06	7.21	2.42	2.36	9.63	8.00	11.99	9.00	1.95	1.50
2390	0.40	0.68	1.08	0.82	5.24	2.74	1.48	7.98	7.00	9.46	9.00	1.59	1.00
2565	1.88	1.52	3.40	3.30	5.20	3.01	1.96	8.21	8.00	10.17	9.00	7.43	7.00
2328	0.43	0.68	1.11	1.03	5.71	2.67	1.47	8.38	8.00	9.85	9.00	2.12	2.00
1319	.....	.....	2.33	1.03	7.18	2.55	1.89	9.73	8.00	11.62	10.00	2.59	2.00
1607	.....	.....	1.48	1.03	6.71	2.16	2.35	8.87	8.00	11.22	9.00	2.42	2.00
2619	1.68	1.78	3.46	3.30	6.09	2.51	2.92	8.60	8.00	11.42	9.00	7.62	7.00
2329	0.62	1.34	1.96	2.05	5.95	3.99	2.74	9.94	8.00	12.68	10.00	3.03	3.00
2109	0.11	1.06	1.17	1.03	5.79	2.89	1.27	8.68	8.00	9.95	9.00	2.20	2.00
2330	0.66	1.40	2.06	2.03	7.17	2.35	2.62	9.52	8.00	12.14	9.00	2.03	1.50
2331	0.26	2.06	2.32	2.05	4.52	3.65	3.87	8.17	8.00	12.04	9.00	2.26	1.50
2332	.....	0.18	0.18	.....	7.54	4.28	1.79	11.82	11.00	13.61	12.00	2.03	2.00
2333	0.23	1.14	1.37	1.03	4.82	3.70	2.47	8.52	8.00	10.99	9.00	2.12	2.00
2566	1.10	1.10	2.20	2.06	5.98	2.07	2.68	8.05	8.00	10.73	.....	3.34	3.00
2335	0.10	0.96	1.06	0.82	5.19	3.87	2.11	9.06	8.00	11.17	9.00	2.12	2.00
2567	0.03	1.23	1.26	1.03	6.22	3.00	2.49	9.22	8.00	11.71	10.00	2.28	2.00
2336	0.72	1.34	2.06	2.06	6.13	4.17	2.33	10.30	8.00	12.63	9.00	3.38	3.00
1395	.....	.....	1.10	1.03	5.82	1.98	2.11	7.80	8.00	9.91	10.00	2.93	2.00
2337	0.56	1.38	1.94	2.06	7.01	2.38	2.55	9.39	8.00	11.94	9.00	2.35	1.50
2377	.....	4.21	4.21	4.12	6.47	1.27	0.26	7.74	7.00	8.00	8.00	9.01	7.00
1230	.....	.....	1.10	0.82	0.69	9.25	2.26	9.94	8.00	12.20	8.00	4.72	4.00
1231	.....	.....	.....	.....	4.11	6.88	4.08	10.99	11.00	15.07	11.00	2.15	2.00
2385	2.38	1.00	3.38	3.29	4.87	3.25	1.86	8.12	6.00	9.98	.....	10.64	10.00
2384	0.42	1.84	2.26	2.06	5.02	4.60	2.35	9.62	8.00	11.98	8.00	2.26	1.50
2568	0.85	1.23	2.08	2.06	5.92	2.31	2.76	8.23	8.00	10.99	9.00	3.37	3.00
2369	0.77	1.22	1.99	2.06	5.68	5.03	2.42	10.71	8.00	13.13	10.00	3.20	3.00
2380	0.49	0.62	1.11	1.25	5.46	2.89	1.35	8.35	8.00	9.70	10.00	1.56	2.00
2368	0.68	1.38	2.06	2.06	6.94	2.92	2.43	9.86	8.00	12.29	10.00	2.16	1.50
2338	0.42	0.64	1.06	0.82	5.46	3.01	1.43	8.47	7.00	9.90	8.00	2.99	1.00
2569	2.13	1.41	3.54	3.30	5.15	2.92	2.14	8.07	8.00	10.21	9.00	7.18	7.00
2339	0.40	0.66	1.06	1.03	5.52	2.66	1.63	8.18	8.00	9.81	9.00	1.97	2.00
2340	0.76	1.34	2.10	2.05	5.69	4.27	2.70	9.96	8.00	12.66	9.00	3.15	3.00
2341	0.52	1.46	1.98	2.06	6.72	2.72	2.32	9.44	8.00	11.76	9.00	1.91	1.50
2570	1.05	1.19	2.24	2.47	4.24	5.57	2.14	5.81	6.00	7.95	7.00	10.70	10.00
2342	0.31	2.10	2.41	2.47	5.64	3.22	3.46	8.86	9.00	12.32	10.00	1.91	2.00
2343	0.26	1.42	1.68	1.25	4.65	2.55	2.15	7.20	6.00	9.35	7.00	3.59	3.00
2571	1.38	1.16	2.54	2.47	5.58	0.47	2.06	6.05	6.00	8.11	.....	10.99	10.00

DESCRIPTIVE LIST OF MANUFACTURERS' SAMPLES, 1901.

Station number.	Manufacturer, place of business and brand.
2344	Packer's Union "Potato Manure"
2345	Packer's Union "Universal Fertilizer"
1619	Packer's Union "Wheat, Oats and Clover Fertilizer"
2393	Quinnipiac Climax Phosphate for All Crops
2347	Quinnipiac Corn Manure
2572	Quinnipiac Market Garden Manure
2573	Quinnipiac Mohawk Fertilizer
2348	Quinnipiac Phosphate
2349	Quinnipiac Potato Manure
2350	Quinnipiac Potato Phosphate
2351	Quinnipiac Seeding Down Manure
2352	Read's Potato Manure
1396	Read's Practical Potato Special
2353	Read's Samson Fertilizer
1397	Read's Standard Fertilizer
2354	Read's Sure Catch Fertilizer
2355	Read's Vegetable and Vine Fertilizer
1414	Standard A. Brand.
2574	Standard Bone and Potash
2394	Standard Complete Manure
2361	Standard Fertilizer.
2362	Standard Guano
2363	Standard Special for Potatoes
2364	Williams and Clark's Americus Ammoniated Bone Superphosphate
2365	Williams and Clark's Americus Corn Phosphate
2366	Williams and Clark's Americus Potato Manure
2575	Williams and Clark's Americus with 10% Potash
2576	Williams and Clark's High Grade Special
2367	Williams and Clark's Potato Phosphate
1236	Williams and Clark's Royal Bone Phosphate for all Crops
	HIRAM BLANCHARD, EASTPORT, ME.
2577	Blanchard's Fish, Bone and Potash.
2578	Blanchard's Ground Fish Scrap No. 2
	THE BOWKER FERTILIZER CO., BOSTON, MASS.
2579	Bowker's Corn Phosphate
2580	Bowker's Early Potato Manure
2581	Bowker's Farm and Garden Phosphate
2582	Bowker's Hill and Drill Phosphate
2583	Bowker's Market Garden Fertilizer
2584	Bowker's Potash Bone
2585	Bowker's Potash or Staple Phosphate
2586	Bowker's Potato and Vegetable Fertilizer
2587	Bowker's Potato and Vegetable Phosphate
2588	Bowker's Six Per cent Potato Fertilizer
2589	Bowker's Square Brand Bone and Potash
2590	Bowker's Sure Crop Phosphate

ANALYSES OF MANUFACTURERS' SAMPLES, 1901.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
			Total.					Available.		Total.			
	Soluble in water.	Insoluble in water.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	%	%	%	%	%	%	%	%	%	%	%	%	%
2344	0.96	1.10	2.06	2.06	4.85	3.16	1.85	8.01	8.00	9.86	9.00	6.54	6.00
2345	0.25	0.96	1.21	0.82	6.05	3.22	1.46	9.27	8.00	10.73	9.00	5.04	4.00
1619	....	....	0.25	.....	.....	.....	1.20	10.92	11.00	12.12	12.00	2.39	2.00
2393	0.39	1.06	1.45	1.03	5.10	3.54	1.63	8.64	8.00	10.27	9.00	2.91	2.00
2347	0.67	1.38	2.05	2.06	6.69	2.63	2.41	9.32	8.00	11.73	9.00	1.95	1.50
2572	2.19	1.39	3.58	3.30	4.23	4.67	1.47	8.90	8.00	10.37	9.00	7.57	7.00
2573	0.03	0.83	0.86	0.82	2.60	4.87	3.86	7.47	7.00	11.33	8.00	1.58	1.00
2348	1.20	1.26	2.46	2.47	6.77	3.06	1.97	9.83	9.00	11.80	10.00	2.43	2.00
2349	1.03	1.50	2.53	2.47	2.55	4.03	3.06	6.58	6.00	9.64	7.00	5.15	5.00
2350	0.74	1.30	2.04	2.06	5.61	4.71	2.36	10.32	8.00	12.68	9.00	3.34	3.00
2351	0.39	0.64	1.03	1.03	5.44	3.14	1.46	8.85	8.00	10.04	9.00	2.61	2.00
2352	0.42	2.28	2.70	2.47	4.59	1.89	1.25	6.48	6.00	7.73	7.00	10.94	10.00
1396	....	.....	1.20	0.83	3.39	1.55	0.54	4.94	4.00	5.48	5.00	8.35	8.00
2353	0.52	1.40	1.92	2.05	6.40	2.35	1.89	8.75	8.00	10.64	9.00	2.93	3.00
1397	.....	.....	1.15	0.83	6.50	1.73	0.92	8.23	8.00	9.15	9.00	4.33	4.00
2354	.....	0.20	0.20	...	4.46	5.17	1.58	9.81	10.00	11.39	11.00	1.91	2.00
2355	0.32	1.80	2.12	2.05	5.94	2.23	1.38	8.29	8.00	9.67	9.00	6.35	6.00
1414	.. ..	.....	1.33	0.82	4.84	3.08	1.96	7.92	7.00	9.88	9.00	1.71	1.00
2574	.....	.. ...	.....	.....	7.66	2.60	1.96	10.26	10.00	12.22	11.00	2.08	2.00
2394	2.40	0.90	3.30	3.30	7.02	1.99	1.04	8.81	8.00	9.85	9.00	7.56	7.00
2361	0.60	1.42	2.02	2.06	6.82	2.43	2.55	9.25	8.00	11.80	9.00	2.01	1.50
2362	0.37	0.70	1.07	1.03	5.31	3.03	1.44	8.34	8.00	9.78	9.00	2.10	2.00
2363	0.82	1.20	2.02	2.05	5.65	5.16	2.40	10.81	8.00	13.21	9.00	2.93	3.00
2364	0.95	1.32	2.27	2.47	6.72	3.08	1.94	9.80	9.00	11.74	10.00	2.35	2.00
2365	0.56	1.42	1.98	2.06	6.75	2.85	2.29	9.60	8.00	11.89	9.00	1.95	1.50
2366	0.64	1.32	1.96	2.06	5.52	4.89	2.23	10.41	8.00	12.64	9.00	3.03	3.00
2575	0.96	1.18	2.14	2.47	4.18	2.29	1.67	6.47	6.00	8.14	7.00	10.62	10.00
2576	2.15	1.39	3.54	3.30	3.80	4.10	2.15	7.90	8.00	10.05	9.00	7.48	7.00
2367	1.02	1.50	2.52	2.47	2.56	4.07	2.94	6.63	6.00	9.57	7.00	5.46	5.00
1236	.....	.....	1.26	1.03	6.20	3.11	2.23	9.30	8.00	11.54	9.00	2.26	2.00
2577	1.27	2.13	3.40	4.00	.....	2.84	2.74	2.84	2.56	5.58	4 28	3.48	2.82
2578	1.25	2.31	3.56	4.00	.....	2.78	1.40	2.78	2.70	4.18	4.40	0.79	1.00
2579	0.40	1.14	1.54	1.50	2.27	5.90	2.19	8.17	8.00	10.36	10.00	2.52	2.00
2580	1.19	1.95	3.14	3.00	3.57	3.49	2.23	7.06	7.00	9.29	9.00	7.33	7.00
2581	0.52	1.16	1.68	1.50	2.30	6.62	2.50	8.92	9.00	11.42	11.00	2.80	2.00
2582	0.71	1.73	2.44	2.25	3.27	5.48	2.76	8.75	9.00	11.51	11.00	2.16	2.00
2583	0.63	1.73	2.36	2.25	3.73	3.01	0.53	6.74	6.00	7.27	7.00	10.46	10.00
2584	0.90	.....	0.90	0.75	3.05	1.93	3.03	4.98	6.00	8.01	8.00	2.10	2.00
2585	0.18	0.74	0.92	0.75	1.69	6.43	2.15	8.12	8.00	10.27	10.00	3.37	3.00
2586	0.61	1.73	2.34	2.25	7.26	2.32	0.83	9.58	9.00	10.41	10.00	4.30	4.00
2587	0.30	1.18	1.48	1.50	2.28	6.79	2.31	9.07	9.00	11.38	11.00	2.32	2.00
2588	0.35	0.65	1.00	0.75	1.39	4.82	3.05	6.21	6.00	9.26	9.00	6.48	6.00
2589	1.03	0.81	1.84	1.50	1.04	3.68	7.10	4.72	6.00	11.82	12.00	2.34	2.00
2590	.....	0.78	0.78	0.75	3.16	6.12	2.31	9.28	9.00	11.59	11.00	2.36	2.00

DESCRIPTIVE LIST OF MANUFACTURERS' SAMPLES, 1901.

Station number.	Manufacturer, place of business and brand.
2591	Bowker's Ten Per Cent Manure
2592	Gloucester Fish and Potash
2593	Stockbridge Corn and Grain Manure
2594	Stockbridge Potato Manure
2595	Stockbridge Seeding Down Manure
	HENRY ELWELL & CO., NEW YORK, N. Y.
2596	Elwell's Eureka Fertilizer
2597	Elwell's Excelsior Potato Fertilizer
	LISTER'S AGRICULTURAL CHEMICAL WORKS, NEWARK, N. J.
2614	Lister's Animal Bone and Potash No. 2
2610	Lister's High Grade Special for Spring Crops
2613	Lister's Seeding Down Fertilizer
2609	Lister's Special Corn and Potato Phosphate
2611	Lister's Success Phosphate
2612	Lister's U. S. Phosphate
	NEW ENGLAND FERTILIZER CO., BOSTON, MASS.
2378	New England Corn Phosphate
2379	New England Potato Fertilizer
	NATIONAL FERTILIZER CO., BRIDGEPORT, CONN.
1886	Chittenden's Complete Fertilizer
2385	Chittenden's Market Garden Fertilizer
	PARMENTER AND POLSEY FERTILIZER CO., PEABODY, MASS.
2598	A. A. Brand
2599	"P. & P." Grain Grower
2346	"P. & P." Potato Fertilizer
2123	Plymouth Rock Brand
2124	Special Potato Fertilizer
2125	Star Brand Superphosphate
	EDWIN J. PHILBRICK, AUGUSTA, ME.
1888	Philbrick's Fertilizer
	THE PORTLAND RENDERING CO., PORTLAND, ME.
1616	Portland Rendering Co.'s Bone Tankage
	PROVINCIAL CHEMICAL FERTILIZER CO., L'T'D, ST. JOHN, N. B.
2560	Provincial Chemical Fertilizer Co's Special Potato Phosphate
	THE RUSSIA CEMENT CO., GLOUCESTER, MASS.
2616	Maine State Grange Chemicals
2617	Maine State Grange Potato Manure
2618	Maine State Grange Seeding Down Fertilizer
2600	Essex A1 Superphosphate
2601	Essex Complete Manure for Corn, Grain and Grass
1411	Essex Complete Manure for Potatoes, Roots and Vegetables
2106	Essex Corn Fertilizer
2602	Essex Market Garden and Potato Manure
2615	Essex Special Potato Fertilizer for Aroostook County
1568	Essex XXX Fish and Potash
	SAGADAHOC FERTILIZER CO., BOWDOINHAM, MAINE.
2603	Aroostook Potato Manure
2604	Dirigo Fertilizer
2605	Sagadahoc Special Potato Fertilizer
2606	Sagadahoc Superphosphate
2607	Yankee Fertilizer
	JOHN WATSON, HOULTON, MAINE.
2608	Watson's Improved High Grade Potato Manure

NOTE—As this bulletin was going to press the Lowell Fertilizer Company applied for licenses for the following brands to be offered in Maine in 1901: Swift's Lowell Bone Fertilizer, Swift's Lowell Animal Brand, Swift's Lowell Potato Manure, Swift's Lowell Potato Phosphate, Swift's Lowell Dissolved Bone and Potash. On application the results of the analyses of these brands will be sent to correspondents.

ANALYSES OF MANUFACTURERS' SAMPLES, 1901.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
			Total.					Available.		Total.			
	Soluble in water.	Insoluble in water.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	%	%	%	%	%	%	%	%	%	%	%	%	%
2591	0.17	0.69	0.86	0.75	1.29	3.92	1.99	5.21	5.00	7.20	7.00	10.34	10.00
2592	0.26	0.56	0.82	0.75	1.18	5.34	2.90	6.52	6.00	9.42	9.00	1.25	1.00
2593	1.29	1.97	3.26	3.00	3.51	1.59	2.04	8.10	8.00	10.14	10.00	7.24	7.00
2594	1.32	1.88	3.20	3.00	2.57	3.54	2.27	6.11	6.00	8.38	8.00	10.34	10.00
2595	0.79	1.59	2.38	2.25	2.97	2.88	4.24	5.85	6.00	10.09	10.00	10.04	10.00
2596	1.01	1.03	2.04	2.00	5.55	2.04	1.95	7.59	7.00	9.54	8.50	7.23	7.00
2597	1.41	1.57	2.98	2.85	4.64	1.27	2.19	5.91	5.50	8.10	7.00	10.63	10.00
2614	.....	.....	.... .	.....	8.01	1.61	1.53	9.62	10.00	11.15	11.00	2.34	2.00
2610	0.59	1.07	1.66	1.65	6.36	1.54	2.23	7.90	.....	10.13	8.00	10.75	10.00
2613	0.28	0.78	1.06	0.83	3.88	3.34	3.03	7.22	7.00	10.25	8.00	1.25	1.00
2609	0.59	1.07	1.66	1.65	5.44	3.22	2.54	8.66	8.00	11.20	9.00	3.23	3.00
2611	0.31	0.99	1.30	1.24	6.16	3.02	2.58	9.18	9.00	11.76	11.00	2.37	2.00
2612	0.22	1.30	1.52	1.03	6.38	2.56	2.86	8.94	8.00	11.80	9.00	2.38	2.00
2378	0.76	1.02	1.78	1.64	3.85	4.93	1.33	8.78	8.00	10.11	9.00	3.23	3.00
2379	0.88	0.88	1.76	1.64	3.46	4.89	.98	8.35	7.00	9.33	8.00	4.28	4.00
1886	.....	.....	3.79	3.30	.....	.....	1.33	9.35	8.00	10.68	10.00	6.31	6.00
2385	1.22	1.00	1.22	2.47	4.45	2.60	2.48	7.05	6.00	9.53	8.00	5.94	5.00
2598	3.14	1.52	4.66	4.53	3.59	4.04	2.03	7.63	7.00	9.66	8.00	8.12	8.00
2599	0.59	.61	1.20	0.82	3.30	4.45	4.32	7.75	7.00	12.07	8.00	2.70	2.00
2346	1.00	0.84	1.84	1.64	2.36	5.15	0.99	7.51	6.00	8.50	7.00	6.91	6.00
2123	0.21	2.08	2.29	2.47	3.81	4.21	1.38	8.02	8.00	9.40	9.00	4.19	4.00
2124	1.69	1.29	2.98	3.29	4.21	4.27	1.29	8.48	8.00	9.77	9.00	7.41	7.00
2125	1.01	0.79	1.80	1.64	3.80	3.54	1.15	7.34	7.00	8.49	8.00	2.60	2.50
1888	0.38	1.65	2.03	2.00	2.00	5.19	1.74	7.19	7.00	8.93	9.00	5.58	5.00
1616	.....	.....	4.27	4.54	.. ..	7.34	12.06	7.34	.....	19.40	16.65	.....	.....
2560	.....	.....	3.46	3.25	6.81	1.44	6.68	8.25	8.00	14.93	10.00	7.20	6.00
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2617	0.63	0.95	1.58	1.50	5.33	4.61	1.82	9.94	9.00	11.76	12.00	10.89	12.00
2618	0.30	1.48	1.78	1.50	4.88	4.94	3.83	9.82	7.00	13.65	13.00	5.52	5.50
2600	0.18	1.34	1.52	1.00	1.96	5.33	4.93	7.29	7.00	12.22	9.00	2.11	2.00
2601	0.97	2.91	3.88	3.30	5.90	3.75	1.50	9.65	7.00	11.15	10.00	9.36	9.50
1411	.....	.....	3.96	3.70	2.60	5.54	2.84	8.14	7.00	10.98	9.00	9.18	8.50
2106	0.52	1.72	2.24	2.00	5.31	4.03	4.14	9.34	9.00	13.48	10.50	3.33	3.00
2602	0.79	1.55	2.34	2.00	5.25	5.17	2.65	10.42	8.00	13.07	10.00	5.06	5.00
2615	1.14	2.06	3.20	2.50	3.09	4.06	4.31	7.15	7.00	11.46	9.00	5.07	5.00
1568	.....	.....	2.68	2.10	8.00	2.63	2.56	10.63	9.00	13.19	12.00	2.75	2.25
2603	0.91	0.47	1.38	1.25	6.00	1.84	1.23	7.84	5.00	9.07	6.00	2.70	2.50
2604	0.29	0.83	1.12	1.50	5.57	3.53	6.17	9.10	7.00	15.27	11.00	1.81	3.00
2605	1.20	0.78	1.98	2.50	4.29	2.32	0.80	6.61	6.00	7.41	8.00	8.34	7.00
2606	0.93	0.79	1.72	2.00	4.45	2.73	1.05	7.18	7.00	8.23	9.00	4.30	3.00
2607	1.03	0.95	1.98	0.50	0.67	4.48	1.50	5.15	3.00	6.65	5.00	1.16	.....
2608	1.56	1.86	3.42	3.00	3.19	3.26	4.19	6.45	6.00	10.64	7.00	5.18	5.00

THE CHIEF PROVISIONS OF THE FERTILIZER LAW APPLYING TO MANUFACTURERS, IMPORTERS AND DEALERS.

The law for the regulation of the sale and alalyses of commercial fertilizers makes the following requirements upon manufacturers, importers or dealers who propose to sell or offer for sale commercial fertilizers in the State:

1. *The Brand.* Each package shall bear, conspicuously printed, the following statements:

The number of net pounds contained in each package.

The name or trade mark under which it is sold.

The name of the manufacturer or shipper.

The place of manufacture.

The place of business of manufacturer or shipper.

The percentage of nitrogen or its equivalent in ammonia.

The percentage of potash soluble in water.

The percentage of phosphoric acid in available form.

The percentage of total phosphoric acid.

2. *The Certificate.* There shall be filed annually between Nov. 15 and Dec. 15 with the Director of the Station a certificate containing an accurate statement of the brand. This certificate applies to the next succeeding calendar year. (Blanks for this purpose will be furnished on application to the Station.)

3. *Manufacturer's Samples.* There shall be deposited annually, unless excused by the Director under certain conditions, a sample of fertilizer, with an accompanying affidavit that this sample "corresponds within reasonable limits to the fertilizer which it represents."

4. *Analysis fee.* For each brand of fertilizer sold or offered for sale in the state there shall be paid annually to the Director of the Station "an analysis fee as follows: Ten dollars for the phosphoric acid and five dollars each for the nitrogen and potash, contained or said to be contained in the fertilizer."

5. *The license.* Upon receipt of the fee, the certificate and the sample (if required), the Director of the Station "shall issue a certificate of compliance."

[The full text of the law will be sent to those asking for it.]

CHAS. D. WOODS, *Director.*

EXPERIMENTS WITH FUNGICIDES ON POTATOES IN 1900.

CHAS. D. WOODS.

As noted in Bulletin 68 of the Station, a spraying experiment with Bordeaux mixture as a preventative of potato blight was successfully carried out on a farm of Mr. John Watson in Houlton. Mr. Watson placed the whole of the potato fields on his farm, and the services of his farm laborers at the disposal of the Station. The experiment was planned partly as a demonstration of the value of Bordeaux mixture when applied on a large scale, and partly as a comparison between freshly prepared Bordeaux mixture and the ready prepared goods on the market.

THE FUNGICIDES USED.

The Bordeaux mixture was prepared according to the following formula.

Copper sulphate	5 pounds
Fresh lime (unslaked)	5 pounds.
Water	50 gallons

A single barrel can be readily prepared as follows:

The copper salt is dissolved in a wooden tub or earthen jar and the lime slaked in a separate vessel. Dissolve the copper sulphate in about two gallons of hot water in a wooden or earthen vessel by stirring, or by suspending it from the top of the vessel in a cloth bag, immersed in the water; pour the solution into the tank or barrel used for spraying and fill one-third to one-half full of water. Slake the lime in a separate vessel by the addition of a small quantity of water, and when slaked add two or three gallons of water and stir freely. Pour the milk of lime thus made into the copper sulphate solution, passing it through a brass wire strainer of about 30 meshes to the inch (No. 50), or through a cheese-cloth backed by common window screen. Stir constantly while adding the lime. Add water to make the amount up to 50 gallons.

In this work, where so much Bordeaux was needed, much time was saved by first preparing stock solutions. The stock solutions used in this experiment were prepared in accordance with the directions given on page 63.

Bowker's Boxal, made by the Bowker Chemical Company, of Boston, is a "manufactured form of Bordeaux mixture," to which an insecticide (disparene or arsenate of lead) has been added. Boxal differs from the usual Bordeaux mixture in that precipitated copper hydrate has been added to it and it contains relatively more copper and less gypsum than ordinary Bordeaux mixture. This added copper hydrate did not soften upon the addition of water as readily or so completely as the other part of the Boxal. The directions on the package called for 5 pounds of Boxal to each 50 gallons of water. Just before the first spraying, a printed postal card was received from the firm saying, "Owing to the remarkable abundance of the potato beetle we are of the opinion that you will obtain the best results by using 10 pounds of Boxal to 50 gallons of water." Accordingly two plots were sprayed with Boxal, one at the rate of 5 pounds and the other at the rate of 10 pounds per acre. If Boxal contains no more copper than Bowker's Bodo,* it will take about 18 pounds to 50 gallons to make a mixture of the same strength as the freshly prepared Bordeaux mixture used in these experiments.

Adler's Bordeaux mixture. This was a prepared mixture so made that each gallon contained 2½ pounds copper sulphate and 2½ pounds of lime. It was used by diluting 1 gallon with 24 gallons of water and thus had the same strength as the freshly prepared Bordeaux mixture.

Lion Brand Bordeaux mixture is prepared by James A. Blanchard, of New York City. It is "ready for immediate use by adding 49 gallons of water to 1 gallon of the mixture." It is put up in gallon cans which retail for one dollar each.

METHOD OF APPLYING.

The fungicides were applied in a fine mist or spray by means of a four-rowed mechanical sprayer, fitted with a powerful hand pump. In the first application the machine was fitted with single

* A manufactured form of Bordeaux mixture, which was not received soon enough to be used in this experiment, but which was successfully used by a few potato growers in Aroostook county in 1900.

Vermorel nozzles and the plots were gone over twice in opposite directions. In the three other sprayings, double Vermorel nozzles were used. Insecticides were used in each application, although in the first and fourth sprayings they were not needed. With the pump used, Bordeaux mixture will be forced through double Vermorel nozzles at the rate of about one barrel to the acre. In practical work on a large scale a spraying outfit with power pump can be advantageously used. In these experiments a hand pump was chosen, as the pressure was then under complete control. As it was desired to take every precaution for thorough spraying, two men were on the cart, one to pump, the other to drive and watch that the nozzles did not get stopped.

ARRANGEMENT OF PLOTS.

The field selected for the test of the commercial Bordeaux mixtures was the same as that used for insecticides (See Bulletin 68). This field was planted with Green Mountain potatoes late in April, the rows running east and west. There were 224 rows about 30 rods long running across the field, and in addition about 20 shorter rows at the north and ten at the south ends of the field. The arrangement of the plots and their treatment is shown in the following plan:

Each plot for the prepared Bordeaux mixture consisted of 18 rows about 30 rods long. The rows ran east and west. Row 1, at north end. Unsprayed rows were left at each end of field.

1 to 16 .....Bordeaux mixture, 1 barrel to acre
17 to 32 .....Bowker's Boxal, 5 pounds to acre
33 to 48 .....Bowker's Boxal, 10 pounds to acre
49 to 64 .....Adler's Bordeaux, 1 gallon to acre
65 to 80 .....Bordeaux mixture, 1 barrel to acre
81 to 96 .....Blanchard's Bordeaux, Lion brand, 1 gal. to acre
97 to 224 .....Bordeaux mixture

Dates of applications:

July 11. Bloom just beginning.
July 21.
July 27. In full bloom.
Aug. 10. Still in bloom.

The fungicides were applied under the personal supervision of the writer, and the fields were visited and full notes taken at frequent intervals.

NOTES TAKEN IN THE FIELD.

July 11. Potatoes just beginning to bloom. No blight of any kind to be seen. All sprayed plots treated today for first time and each row sprayed twice, once from the east and once from the west, with single Vermorel nozzle. It began to rain after the plots were sprayed.

July 21. All plots sprayed once with double Vermorel nozzle. Untreated rows sprayed with lime and Paris green. It began to rain after plants were sprayed.

July 24. Potatoes in full bloom. Rows 1 to 16. Plants very well covered with Bordeaux mixture. Rows 16 to 32 very little indication of Boxal on foliage. Rows 33 to 48 Boxal readily seen on foliage. Well distributed. Rows 49 to 64. Plants well covered with Bordeaux mixture, although it does not show up as plainly as on rows 1 to 16. Rows 65 to 80. Leaves fairly well covered with Bordeaux mixture. Rows 81 to 96. Bordeaux shows up about the same as Boxal on rows 33 to 48. Rows 97 and beyond well covered with Bordeaux mixture.

July 25. Heavy Rain.

July 27. All plants sprayed. The mixtures were applied from the direction opposite to that of July 21.

Aug. 1. Heavy shower last night. Field still white with bloom. The tops are nearly touching between the rows all over the field. On the very steep slopes, and particularly at the foot, plants did not get as well sprayed. Rows 1 to 16. Bordeaux mixture on all the leaves except the very newest. Rows 17 to 32. Boxal shows a little on the leaves. Rows 33 to 48. Boxal shows much plainer than on rows 17 to 32. Rows 49 to 64. Bordeaux mixture about as conspicuous as the Boxal on rows 33 to 48. Rows 65 to 80. Bordeaux mixture conspicuous on all except last new leaves. Rows 81 to 96. Bordeaux does not show as evenly over the leaves as the regular Bordeaux does. Rows 97 and beyond. Bordeaux mixture well distributed.

Aug. 3. Heavy rain.

Aug. 8. Plants have grown 8 to 15 inches since last spraying (July 27). Blossoms are beginning to fall. No signs of blight unless it be five or six blackened leaves on rows 193 to 208. The spraying still covers the old leaves.

Aug. 10. Sprayed rows 1 to 112. It thickened up and began to sprinkle while rows 97 to 112 were being sprayed. The

shower was very light but it did not clear up again during the day. Blight was reported as having been found in several fields in Houlton and vicinity. No signs of blight in this field unless it be on a few leaves on north unsprayed end rows.

Aug. 11. Rows 113 to 224 sprayed.

Aug. 14. Plants still in bloom so that the blossoms are conspicuous at a distance. Came up unexpectedly because of telegram saying that blight had appeared in the field. The blight was apparent in a few places on the low parts of the whole field. The plants were all carefully examined and the following notes taken: Rows 1 to 16. For two rods at east where ground is low and soil heavy, it has been very wet and plants are small and poor. There is some blight here on lowest leaves. In a hollow near east end where the plants are rank, soft and "leggy," there is a little blight on a few of the lowest leaves. Otherwise practically no blight on plot. Rows 17 to 32. Very well sprayed. A few leaves are brown, or have brown tips. If there was no blight elsewhere should not suspect these. Rows 35 to 48. Well sprayed. There are a few blackened leaves, apparently bruised at last spraying. Very little, if any, suspicions of blight. Rows 49 to 64. Well sprayed. No indications of blight. Rows 65 to 80. Well sprayed. No indications of blight. Rows 81 to 96. A few plants at extreme east with brown particles on leaves but it does not look like blight. Last spraying not conspicuous on the wet (with dew) leaves, but careful examination shows that it is there. If there was no blight elsewhere, I should say there was no reason to think there was any on this plot. Rows 97 to 112. Well sprayed. An occasional brown spot which may be blight, but should not think so if it were not for blight elsewhere. Rows 113 to 128. Pretty well sprayed. A few black patches which look like blight on some of the lowest leaves. This is especially the case at the east end where plants are rankest. Rows 127 to 144. For three or four rods at west end many of the lowest leaves are dead with blight. Some indications of blight all along. Less in the middle and east except that for 1 rod at east end there are quite a number of dead leaves. Rows 145 to 160. Very little indication of blight except in west end where a few leaves are dead or nearly so. Not nearly as bad as west end of rows 129 to 144. Rows 161 to 176. Pretty well sprayed. Very little if any indications of blight; should not be

suspicious if blight were not on other plots. Rows 177 to 192. Pretty well sprayed. Only an occasional leaf with blight spot except on west end, where for four rods quite a good many of the lowest leaves are dead. Rows 193 to 208. Spraying not very good. At west end many of lowest leaves dead with blight. The blight grows less and less for 6 to 8 rods, beyond which there are very little indications of blight except in a hollow where water stands after a rain, and on a knoll near the east end (the potatoes on this knoll when dug were scabby). Rows 209 to 224. Fairly well sprayed. Very little indications of blight on east half. West half about the same as 193 to 208. Unsprayed rows at north end of field. Tops at east end very large and spreading. At west smaller with blossoms mostly fallen. Blight on east part abundant on lower leaves. A good many lower leaves dead and many others with spots of blight a half inch or more across. Very little rust on middle and west end. Unsprayed rows at south end of field. Blight abundant in marked contrast to rows 209 to 224 adjoining.

Aug. 23. Walked through each plot and made notes. The blossoms are practically off from the whole piece. Some of the plants are beginning to turn yellow,—apparently ripening. The effect of spraying with copper salts is very evident on all the plots. Some plots are still entirely free from blight. Rows 1 to 16. Blight has made very little progress; there is practically none except on the east end for 4 rods or so and no badly affected plants. Rows 17 to 32. A little blight on the whole plot. The plants at east end and in hollow have considerable, others very little blight. Many plants entirely free from blight. Rows 33 to 48. Practically no blight on west half. The east slope (quite steep) has some blight for 2 rods. Otherwise no blight except on an occasional leaf. Rows 49 to 64. Practically no blight. A few leaves on east side of slope (steep, but not so steep as on rows 35 to 48) show signs of blight. Rows 65 to 80. Practically no signs of blight. A few leaves are brown and curled on edges. No spots as in blight. Rows 81 to 96. A few blight spots in leaves on most of the plants. There are practically no dead leaves, however. Rows 97 and beyond. The blight has made practically no progress on these plots since Aug. 24. The leaves which were badly affected then are dead. Very little new blight apparent.

Sept. 4. Field as a whole doing finely and ripening. Rows 1 to 16. Blight making no progress. Rows 17 to 32, 33 to 48, 49 to 64. Blight making some progress, but probably not enough to seriously interfere with growth and ripening. Rows 65 to 80. Practically no blight. An occasional leaf on an occasional plant shows a small spot. Rows 81 to 96. Blight has made little advance since Aug. 23. Some dead leaves. Rows 97 to 224. Blight has made little, if any progress, since August 14. Unsprayed rows at north end of field. Some plants only a little affected with blight. Most of the plants are three-fourths dead with blight. Unsprayed rows at south of field. Except on the north side of the row next to 224 there is not a green leaf. The stalks are for the most part still standing and are green.

Sept. 7. Plants badly checked and nearly killed by severe frost. The top leaves are all blackened.

Sept. 29. Because of inequalities in the field it was not practicable to select even twentieth acre pieces in each plot that would be fairly comparable in yield with the different fungicides. At harvest there was very little rot found on any of the sprayed plots. There were rather more rotten potatoes on the Boxal and Blanchard's Bordeaux plots than on the others. But even these had so few rotten potatoes that they could be fairly said to have "practically no rot." The Adler's Bordeaux which differed from the regular Bordeaux only in not being freshly prepared, gave only 5 decayed potatoes in a row 30 rods long which was as well as in the case of the freshly prepared Bordeaux mixture.

YIELD FROM UNSPRAYED AND SPRAYED ROWS COMPARED.

The vines at the south end of the field were not as rank nor the yield as great as at the north end of the field. On rows 1 to 16 and 209 to 224 and on the unsprayed rows which joined these plots, twentieth acre strips (apparently similar except that one had been sprayed and the other was not) were measured and the crop harvested, Sept. 29. The yield was as follows:

YIELD OF POTATOES FROM ADJOINING SPRAYED AND UNSPRAYED 1-20 ACRE PLOTS.

	Yield of Potatoes.					
	Pounds per 1-20 Acre.			Bushels per Acre.		
	Merchantable.	Small.	Rotten.	Merchantable.	Small.	Rotten.
North part unsprayed.	553	96	101	184	32	34
Adjoining rows sprayed.....	957	95	.....	319	32	.....
South part unsprayed.	330	94	81	110	31	27
Adjoining rows sprayed...	738	90	.....	246	30	.....

READY MADE VS. FRESHLY PREPARED BORDEAUX MIXTURE.

Effectiveness. The Boxal and Lion brand Bordeaux mixture, in the amounts used in these experiments, contained less copper than the regular Bordeaux mixture. The Adler's Bordeaux mixture, however, was applied so that it was of the same strength as the freshly prepared Bordeaux mixture here used. Both as indicated by freedom of vines from blight and tubers from rot, the ready made Bordeaux (Adler's) apparently was as effective as the freshly made. The Boxal and Lion brand Bordeaux mixture was not quite as effective in preventing blight and subsequent rot of the tubers as the freshly prepared mixture. This may be explained by the fact that as used, these goods did not carry as much copper as the regular Bordeaux mixture.

In these experiments Bordeaux mixture which had been made for weeks was as effective in preventing blight and subsequent rot as the freshly prepared. Boxal and Blanchard's Lion brand Bordeaux mixture protected the plants and the tubers from destruction by blight and rot. While in these experiments they were not as effective as the regular Bordeaux mixtures, they can under most conditions be depended upon to protect the potato plant. They would probably be more effective if used in stronger mixtures.

"The Ready for Use" Feature. The claim is justly made by the manufacturers that the prepared Bordeaux mixtures are

ready for use, since they only need to be diluted with the requisite amount of water. If one is using much Bordeaux mixture this is of little practical importance, for by using stock solutions freshly prepared Bordeaux mixture (with allowance for time of preparing stock solution) can be as quickly prepared as the ready made goods can be stirred up and diluted.

The Cost. Copper sulphate costs at retail, in lots of 50 to 200 pounds, about 7 cents per pound. Lime costs about 50 cents a hundred by the cask. Thus the materials for making a barrel (50 gallons) of Bordeaux mixture costs between 40 and 50 cents. The prepared goods *of this strength* are practically as good as the freshly prepared. The small grower will probably find the ready made goods enough more convenient to justify a somewhat higher cost. The large grower should not with present prices pay much more than at the rate of 50 cents for enough material to make a barrel of the mixture. The trouble of preparing the mixture from lime and sulphate of copper is slight. Enough lime to make ten barrels of the mixture was weighed out, slacked and strained by the writer in 23 minutes. Making the copper sulphate solution takes practically no labor, although it will be several hours after it is suspended in the water before it will be all dissolved.

DOES SPRAYING WITH COPPER SALTS PAY?

In the experiments here reported upon, four sprayings with Bordeaux mixture at a cost, including labor of man and team, of not more than at the rate of $2.50 per acre gave 280 bushels of first-class potatoes as against a yield of 147 bushels of green and too small potatoes to command a ready sale. At the prices which prevailed at time of digging, the crop from the sprayed would have sold for $106.40; $102 for the merchantable and $4.40 for the starch potatoes. The crop on the unsprayed would have sold only with difficulty except for starch, but assuming that the so-called merchantable could have been sold for the same price as the sprayed, the money value of the crop would be $62.60; $53.50 for the good potatoes and $9.10 for the starch potatoes. The investment of $2.50 gave at the least a money return of more than $40.00 per acre.

To be effective, spraying must be rightly done and at the proper time. Full directions for spraying the potato are given in the article which follows.

HOW TO FIGHT POTATO ENEMIES.

CHAS. D. WOODS.

Because of the importance of the subject and numerous inquiries from correspondents, the following specific directions for combatting the more common insect and fungus enemies of the potato have been prepared. The directions are based not only upon our experiments, experience and observation, but upon those of other investigators and practical growers in this and other states.

By far the larger part of the enemies of the potato may readily be held in check by spraying with the more common insecticides and fungicides, and often, by a combination of materials, several enemies may be met with one application. The insect enemies can be met *after* they appear. The fungus diseases can be prevented and the successful fight must be made *before* they appear. In some seasons there is comparatively little loss from the attack of fungus diseases. In others the crop is a failure unless preventive measures are taken. No man can tell beforehand whether the season will be favorable to the growth of the fungi or not. The moral is evident. Preventive measures must be taken with each crop.

INSECT ENEMIES.

The flea beetle, which eats small round holes in the leaves, and the Colorado beetle ("potato bug"), which prefers the leaves, eats the stems and will eat the tuber if nothing else offers, readily succumb to poison. Their very greediness makes them the easier victims.

No adequate substitute for arsenical poisons has yet been found. Some things are distasteful and if abundantly applied will drive the beetles. Paris green is the most generally used. Lead Arsenate proved the most satisfactory with us.* To kill all the bugs the poison must be distributed over the entire plant. This is most readily and surely done by spraying. See formulas 3, 3a, 4 and 4a.

*For results of experiments with insecticides on potatoes see Bulletin 68 of this Station.

FUNGUS DISEASES.*

While there are several fungus diseases which attack the potato, the scab and the early and late blight are the most prevalent and the ones most to be feared in Maine.

POTATO SCAB.

Potato scab, which is too well known to need description, can be held in check by planting previously treated seed in clean land. As it is next to impossible to get this fungus out of the soil, great care should be taken not to get it in. Soak the uncut seed potatoes for two hours in either formula 1 or 1a and then spread out to dry. After drying the potatoes may be cut and planted in the usual way, care being taken not to allow them to touch any box, bag or bin where scabby potatoes have been kept. All treated tubers should be planted to avoid danger from the poison on them.

EARLY BLIGHT.

This disease is wide spread and destructive. It is confined to the leaves and green stems, and appears about the time the tubers begin to form, but may come earlier if the growth of the plants has been checked in any way. The first indication of its presence is the appearance on the leaves of grayish brown spots, which soon become hard and brittle. The disease progresses rather slowly, the spots gradually becoming larger, especially along the edges of the leaflets. At the end of ten days to two weeks half of the leaf surface may be brown, withered, and brittle, while the rest is of yellowish green color. The tubers stop growing almost as soon as the leaves are attacked, and as a result the crop is practically worthless. This can be prevented by the use of Bordeaux mixture, formula 2.

LATE BLIGHT, OR ROT.

This disease attacks the leaves, stems and tubers. Generally the first noticeable effect upon the leaves is the sudden appearance of brownish or blackish areas, which soon become soft and foul smelling. So sudden is the appearance of the disease in some cases, that fields which one day look green and healthy may within the next day or two become blackened as though swept

*For illustrated description of the fungus diseases of the potato send to your congressman, or the Secretary of Agriculture, Washington, D. C., or to this Station for Farmers' Bulletin No. 91 of the U. S. Department of Agriculture.

by fire. The rapid spread of the disease, which is caused by a parasitic fungus, is dependent in large measure upon certain conditions of moisture and heat. A daily mean temperature of from 72° to 74° F. for any considerable time, accompanied by moist weather, furnishes the best conditions for the spread of the parasite. On the other hand, if the daily temperature exceeds 77° for a few days, the development of the disease is checked. This fact explains why the fungus seldom occurs to any serious extent in sections where the mean daily temperature exceeds 77° for any length of time, and probably why it appears later than the so-called early blight. The late blight not only stops the growth of the tubers but causes them to rot. Bordeaux mixture (formula 2) will prevent this.

LEAF DISEASES, ETC., RESEMBLING BLIGHT.

Leaf burn or scald sometimes occurs and may be confused with early blight. The tips and edges of the leaves turn brown and these discolored areas soon become hard and brittle. The burning or scalding may occur at any time and is the result of unfavorable conditions surrounding the plant. Long continued cloudy and damp weather followed by several hot and bright days is apt to result in the burning of the foliage. Leaf burn may also occur as the result of protracted dry weather.

Leaf poisoning or burning may occur where Paris green is applied to potatoes and frequently it can not be distinguished from early blight by any ordinary examination. It sometimes happens, therefore, that farmers are led to believe that their potatoes are affected with early blight and other diseases when the trouble has been brought on by themselves through the improper use of Paris green. Injuries resulting from the use of this substance are very apt to occur where flea beetles have eaten the foliage. The arsenic attacks the tissues at such points, and as a result more or less circular brown spots are produced, having for their centers the holes eaten out by the flea beetles. By combining the Paris green with Bordeaux mixture or with lime, these injuries may be avoided.

HOW TO SPRAY.

Spraying is an effective method of applying inseeticides and fungicides. To obtain the best results, the material must be applied forcibly in the form of a fine mist, *not* in coarse drops sprinkled over the foliage. Inasmuch as spraying is a preventive measure (not a cure) the whole surface of the plant must, so far as possible, be covered.

THE APPARATUS.

The necessary apparatus consists of a force pump, hose, nozzles, a barrel for holding the spraying mixture and a wagon for carrying all.

The Pump: The pump should be large enough to easily supply 4 double nozzles and should have as an accessory a good agitator. The small bucket pumps and knapsack sprayers do very well for a few plants in the kitchen garden, but for field work they are unsatisfactory. All parts of the pump that are subject to wear should be made of brass and should be carefully adjusted. The pump and all other apparatus should be thoroughly washed every time after using.

The Hose: In case an automatic sprayer is not used, 2 pieces of 1-2 inch hose 10 to 20 feet long are needed.

The Nozzle: There are many good nozzles, but the best tried at the Experiment Station, are the Vermorel, sold by most dealers in spraying apparatus; the McGowen, made by John J. McGowen, Ithaca, N. Y., and the Bordeaux, made by the Deming Company, Salem, Ohio. The Vermorel throws a finer spray than the others, and is the best for potatoes, but is easily clogged unless the spraying mixture is carefully strained through cheesecloth or a fine wire screen before using. With automatic sprayers, double nozzles should be used.

The Barrel: A kerosene barrel, holding about fifty gallons, is a convenient tank. It can be placed upon the side or stood on end, but the first position is preferable. A small opening should be made in which to place the pump, and another, larger one, through which to fill the tank and stir the mixture.

The Wagon: Any low wagon, or even dump-cart will answer the purpose. For convenience in turning, a two wheeled cart is to be preferred.

Automatic Sprayers: In large fields automatic sprayers which will cover four rows at once may be used with satisfactory results. Such a machine consists essentiallv of a barrel, containing an agitator for keeping the liquid stirred, mounted upon a two wheeled cart, a force pump (which may be a hand pump, but preferably one driven by a spocket chain in the rear) with nozzles which can be set to any width of row. To give the best results two nozzls should be used for each row. Combinations of two nozzles can be obtained from dealers.

FORMULAS.

CAUTION: *The following formulas are for use on the potato. In many cases they are not adapted for more tender plants. Keep all poisons carefully labelled and out of the reach of children and animals.*

Formula 1. CORROSIVE SUBLIMATE.

Corrosive Sublimate .....2 ounces
Water .....15 gallons

The corrosive sublimate dissolves readily in water.

Formula 1a.

Formaline (40% solution formaldehyde).....8 fluid ounces
Water .....15 gallons

Formula 2. BORDEAUX MIXTURE.

Copper Sulphate .....5 pounds
Fresh Lime (unslacked).....5 pounds
Water .....50 gallons*

The copper salt is dissolved and the lime slacked in separate vessels. Dissolve the copper sulphate ("Blue Stone") in about two gallons of hot water in a wooden or earthern vessel by stirring, or by suspending it from the top of the vessel in a cloth bag; pour the solution into the tank or barrel used for spraying and fill one-third to one-half full of water. Slack the lime by the addition of a small quantity of water, and when slacked add two or three gallons of water and stir freely. Pour the milk of lime thus made into the sulphate solution, passing it through a brass wire strainer of about 30 meshes to the inch (No. 50) or through a cheese-cloth backed by common window screen.

* An ordinary oil barrel holds about 50 gallons.

Stir constantly while adding the lime. Add water to make the amount desired.

Much time may be saved by preparing stock solutions. While any proportions can be used, the following was found in the spraying experiments made by the Station a convenient way:

The stock solution of copper sulphate is made by weighing out 50 pounds of copper sulphate, placing it in a bag and suspending it in the top of a barrel containing 30 gallons of water. The copper sulphate dissolves completely in a few hours. The stock solution of the lime is prepared by slacking 50 pounds of lime, and adding water so as to make up to 30 gallons and straining through No. 50 brass screen cloth. To slack and strain this amount of lime takes less than one-half hour. For use, 3 gallons of each solution and 44 gallons of water make up the formula give above. The stock solution of lime should be kept well covered and be thoroughly stirred before dipping out.

Formula 3. BORDEAUX MIXTURE AND PARIS GREEN.

Paris Green ..... ½ pound
Bordeaux Mixture ..... 50 gallons

Make a paste with the Paris green and a little water. Add to the Bordeaux mixture and stir thoroughly.

Formula 3a. BORDEAUX MIXTURE AND LEAD ARSENATE.

Lead Arsenate or Disparene ..... 1 pound
Water ..... 50 gallons

Formula 4. PARIS GREEN.

Paris Green ..... ½ pound
Lime (unslacked) ..... 3 pounds
Water ..... 50 gallons

The standard remedy for the destruction of insects which eat the foliage or fruit. The lime is added to prevent the Paris green from burning the foliage. Slack the lime in a little water, make into a thin paste and strain. Wet up the Paris green with a little water into a thin paste. Mix the lime and Paris green and add the remainder of the water. A stock solution of lime can be made as described under formula 2.

Formula 4a. LEAD ARSENATE.*

Lead Arsenate .....1 pound
Water .....50 gallons

Arsenate of Lead acts slower as a poison than Paris green. It can be kept suspended in the water better than Paris green; it does not burn foliage and sticks to the foliage better than Paris green. For these reasons it proved, in our experiments in 1900, more satisfactory than Paris green.

WHAT TO DO, AND WHEN AND HOW TO DO IT.

The treatment at various times during the season and the purpose of the same, briefly stated, are as follows:

A. Corrosive Sublimate (formula 1) or Formaline (formula 1a): before planting immerse the tubers for two hours, then dry and cut. For scab.

B. Bordeaux mixture and Paris green (formula 3) or Bordeaux mixture and lead arsenate (formula 3a): when the plants are three or four inches high, or as soon as the potato beetle appears. For potato beetle, flea beetle, and early blight.

C. Repeat B at intervals so as to keep new leaves protected.

D. Bordeaux mixture (formula 2) about August 1 to 15. For late blight and rot.

E. Repeat D after about two weeks.

Four sprayings are usually sufficient to protect from blight.

Begin while the tops are still small and spray again as soon as tops have made 6 or 8 inches of new growth and keep this up as long as the tops are growing rapidly.

Directions for spraying the apple and how to fight cucumber enemies will be sent on application.

CHAS. D. WOODS, *Director,*
Orono, Maine.

*Swift's Lead Arsenate or Bowker's Disparene.

THE MANURIAL VALUE OF ASHES, "MUCKS," SEA-WEEDS AND BONE.

CHAS. D. WOODS.

In his efforts to grow crops the intelligent farmer must ever try to conserve and add to the stock of available plant food in the soil. The fertility of a soil is measured by its power to produce crops. A soil may have many hundreds of pounds of plant food per acre, and still be unfertile, while another may contain little plant food, but may have that little in an available form and thus be productive, i. e., fertile.

Usually manures are applied to soils for the double purpose of supplying plant food in an available form and unlocking the unavailable compounds already in the soil. The direct manurial value of fertilizing materials of the *same class* can be accurately measured by chemical analysis. Sometimes as the results of field and pot experiments it is also possible to extend this comparison of analyses to materials of unlike nature. In general, however, it is not enough to know the pounds of nitrogen, phosphoric acid and potash in a given manure, but we must by actual experiment with the living plant find out how much of these materials is available to the plant. In studying the manurial value of the three classes of fertilizing materials discussed in this bulletin, these facts must be kept in mind. For example, in comparing a "muck" with 2½ pounds of nitrogen in 100 pounds of dry matter with stable manure with only 1¾ pounds of nitrogen in the same weight, a great mistake would be made in thinking the muck a better fertilizer than the manure. The nitrogen of the muck is largely unavailable as plant food until it has been treated by composting, exposure to the air, etc., while the stable manure contains in itself the ferments necessary to render its nitrogen available to the growing plant. In like manner the

phosphoric acid of a superphosphate is in a form ready to be assimilated by the growing plant, while that of wood ashes may be practically insoluble and only slowly available to the plant.

If plant food is not in an immediately available form the material containing it may still possess manurial value. To utilize all kinds of plant food at one's disposal is an important item in farm economy. The classes of such materials more or less accessible to the farmers of Maine are ashes, "mucks" seaweeds and bones. Partly because of accumulated unpublished analyses of samples sent to the Station by correspondents and partly in answer to inquiries respecting the manurial value of these materials, this bulletin has been prepared.

Wood Ashes.

Maine farmers are pretty well agreed as to the high value of wood ashes as a fertilizer. The fertilizing value of wood ashes is commonly attributed to the potash which they contain. While the potash has the largest money value of the fertilizing constituents of ashes, their agricultural value also depends upon the not inconsiderable amounts of phosphoric acid and the large amounts of lime which they carry. The importance of these last constituents is indicated by the high value some farmers put upon leached ashes as a manure, although in leaching nearly all of the water soluble potash has been removed. The potash content of ashes varies with the kind of wood, the method of burning, and the care taken of the ashes to protect them from rain.

The Ontario Agricultural College* has made quite a study of the composition of the ashes of different woods. And while these results, usually from single specimens, cannot be taken as final, they are suggestive and instructive. Some of the more important of these analyses are given in the table which follows.

*Report Ontario Agricultural College and Experimental Farms, 1896, pp.24-26.

POUNDS OF PHOSPHORIC ACID, POTASH AND LIME IN 100 POUNDS WATER-FREE ASH OF THE WOOD OF THE TREES INDICATED.

Kind of wood.	Phosphoric acid.	Potash.	Lime.
Sugar Maple	2.03	9.31	45.24
Soft Maple	1.29	9.52	41.97
Black Ash	1.20	25.30	49.04
Oak	1.69	9.39	43.54
Birch	1.47	8.58	37.10
Elm	.45	35.37	23.64
Beech	1.39	7.58	41.21
Apple	1.81	4.84	44.93
White-Ash	.93	16.88	37.14
Basswood	5.28	9.39	33.42
Poplar	2.98	10.42	28.38
Hemlock	2.76	8.73	45.83
Pine	4.03	11.22	20.28
Cedar	.98	3.30	49.06
Spruce	4.00	8.98	25.82

As stated above, the results of the analysis of single specimens of wood can be taken as indications only. In two instances this Station has analyzed the ash of known woods with results differing from the above as follows:

PHOSPHORIC ACID AND POTASH IN 100 POUNDS ASH OF BIRCH AND CEDAR. THE RESULTS OF MAINE ANALYSES COMPARED WITH THOSE OF CANADA.

	Phosphoric acid.	Potash
Birch, Maine analyses	6.05	12.04
Canada analyses	1.81	8.58
Cedar, Maine analyses	1.91	5.09
Canada analyses	.98	3.30

With allowance for individual variations the results are striking and interesting. The popular idea of the low value of beech ashes is confirmed but the prevailing belief in the low value of soft wood ashes as compared with hard wood ashes does not seem to be well founded. The potash in maple, oak, birch

and beech averages rather less than that of hemlock, pine and spruce. While this is true of the carefully prepared ashes, it does not seem to hold in the case of ashes actually made in burning. The following table shows the analyses of different samples of gathered ashes made by this Station:

POUNDS OF FERTILIZING CONSTITUENTS CONTAINED IN 100 POUNDS OF DIFFERENT SAMPLES OF WOOD ASHES ANALYZED AT THE MAINE STATION.

Laboratory number.	Kind of ashes.	Water.	Phosphoric acid.	Potash.			Lime.
				Soluble in water.	Insoluble in water.	Total.	
	UNLEACHED ASHES.						
71	Hard wood	4.40	3.00	7.12	1.34	8.46	38.60
74	Mostly hard wood	.80	2.56	7.74	1.26	9.00	36.59
85	Pure birch wood	.06	6.05	10.43	1.61	12.04	39.07
82	Hard wood	3.30	2.98	5.24	2.68	7.27	31.65
250	Hard wood	.....	2.00	7.82	.....	.....	.....
3003	Hard wood, Canada	.....	.....	9.65	.....	.....	.....
3013	Hard wood, Canada	.....	.....	8.09	.....	.....	.....
	Hard wood, average	2.40	3.32	8.01	1.56	9.57	36.48
70	Soft wood, household fires	4.64	1.78	2.64	2.01	4.65	23.62
834	Cedar ashes	1.52	1.91	5.09	.....	.....	.....
	Dump ashes:						
64	Soft wood, mostly spruce	20.63	.64	2.38	.64	3.02	29.36
66	Soft wood, mostly spruce	3.84	1.50	1.35	1.27	2.62	31.22
67	Soft wood, mostly pine	.....	.66	.40	1.13	1.53	37.72
86	Mill waste, mostly spruce	.....	1.58	1.90	1.16	3.06	38.72
	Soft wood, dump, average	.....	1.09	1.51	1.05	2.56	34.25
	Mill furnace ashes:						
65	From spruce sawdust	1.19	1.40	3.43	.96	4.39	35.90
68	Soft wood, mostly spruce	.....	1.27	.88	1.05	1.93	46.14
69	Soft wood, mostly spruce	88	1.47	3.50	1.70	5.20	46.20
587	Soft wood, mostly spruce	...	2.70	4.69	.....	.....	.....
3004	Soft wood, mostly spruce	..	.....	2.56	.....	.....	.....
3014	Soft wood, mostly spruce	..	.....	5.70	.....	.....	.....
	Soft wood, furnace, average	.....	1.66	3.46	1.24	4.70	42.75
	Canada ashes—car lots:						
3024	.....	.....	.....	3.27	.....	.....	.....
3025	.....	.....	.....	5.68	.....	.....	.....
3026	.....	.....	.....	6.64	.....	.....	.....
3042	.....	.....	.....	4.54	.....	.....	.....
3043	.....	.....	.....	3.85	.....	.....	.....
3084	.....	.....	.....	5.71	.....	.....	.....
	Canada ashes, average	.....	.....	4.95	.....	.....	.....
76	Spent tan bark ashes	1.05	1.44	.98	1.12	2.10	.....
843	"Muck" ashes	.....	Trace	.....	.....	Trace	.....
	LEACHED ASHES.						
72	Hard wood	32.95	1.91	.46	.97	1.43	25.48
75	Mostly hard wood, mixed	31.25	1.54	.35	.93	1.28	20.00
77	Mostly hard wood, probably	31.22	1.52	.90	.56	1.46	32.97
80	Mostly hard wood	31.40	1.96	1.13	.72	1.85	29.06
73	Soft and hard wood, mixed	34.05	1.42	.29	1.32	1.61	20.54
81	Mostly hard wood, Canada	25.43	1.60	.94	.59	1.53	31.12
	Leached ashes, average	31.05	1.66	.68	.85	1.53	26.58

For the purpose of clearness the averages of the preceding table are given in a concise form in the table which follows:

POUNDS OF WATER, PHOSPHORIC ACID, WATER SOLUBLE POTASH AND LIME IN 100 POUNDS OF DIFFERENT CLASSES OF WOOD ASHES.

Kinds of ashes.	Water.	Phosphoric acid.	Potash soluble in water.	Lime.
Unleached hard wood		3.3	8.0	36.5
Unleached soft wood, household		1.8	2.6	23.6
Unleached soft wood, dump		1.1	1.5	34.3
Unleached soft wood, mill furnace		1.7	3.5	42.8
Unleached Canada, car lots			5.0	
Leached mixed wood	31.0	1.7	.7	26.5

The results of the analyses indicate very clearly that different samples of ashes differ markedly in their manurial value. The unleached hard wood ashes are of much greater value than those of soft wood. As seen from the table on p. 67 this cannot be attributed chiefly to the kind of wood, but more to the method of burning and subsequent care. Potash is volatile at a not very high temperature and in case of very hot fires much of the potash would be driven off and lost. Dump and furnace ashes are more or less exposed to the weather. The rains if copious enough to wet through the pile would leach the ashes and carry off more or less of the water soluble potash. In case of a dry pile partially wet, the water falling upon the top will dissolve out the potash in the upper layers and carry it to the lower part of the pile. In the case of damp ashes drying out, the movement of water is toward the top and the water containing the potash would be drawn to the top and evaporate, leaving at the top of the pile the potash in the form of a more or less crystalline crust. With the next rain this would be dissolved and carried down into the pile to again reappear at the surface in subsequent evaporation of the moisture. It therefore follows that the composition of a pile of wet ashes is not uniform and that portions of it

would be poorer than other parts in plant food. In selecting samples for analysis great care needs to be taken in order to be sure the sample fairly represents the whole.

The potash insoluble in water is chiefly the silicate of potash which is only slowly if at all available to plants. The phosphoric acid is all in insoluble form and how readily available is not known.

In addition to their manurial value, ashes have a decided effect upon the capillary power of the soils. If a solution of carbonate of potash, such as potash of wood ashes, is poured upon loam, it will be made muddier and stickier than it would be if moistened with water. Milton Whitney of the United States Department of Agriculture has investigated this subject and finds that alkaline solutions seem to loosen the particles of the clayey soil from the particles of sand and float off the clay particles, so as to fill up the spaces between the sand grains. As a result of this clogging of the pores, the circulation of the water is much retarded. That this action of an alkali is sometimes of great practical importance is attested by the fact observed by Whitney, that soils are met with in which the particles of clay are held so closely to the grains of sand that the soil has the appearance and properties of a sandy soil, although it may actually contain as much clay as many so-called clay soils. Carbonate of potash has a tendency to keep clay in a "puddled" condition. A ball or lump of moist clay, held together with alkaline carbonate does not tend to crumble during the process of drying, but remains a hard lump. As unleached ashes carry large amounts of potash lye, the application of ashes may have practically the same effect upon soils as the addition of carbonate of potash.

Potash soils also have a decided action upon soil nitrogen. These alkaline solutions have great power to dissolve organic matters and render unavailable nitrogen available. This tendency of potash to promote rank growth is well illustrated wherever the land has been recently cleared of wood and the logs burned. The rankness of growth which follows is probably due not only to the available potash thus returned to the soil, but also to the superabundant supply of nitrogenous food made available by the action of the alkali upon the soil humus and to the fact that alkali has a tendency to retain moisture.

A favorite way of applying wood ashes is as a top dressing to mowing or pasture lands. This encourages the growth of clover and some of the better grasses, with a tendency to crowd out inferior kinds of grasses, weeds and moss.

The presence of an alkali seems to favor the growth of potato scab. On land free from scab fungus, ashes are beneficial for potatoes. Leached ashes depend chiefly upon the phosphoric acid and lime for their value. Coal ashes have no fertilizing value and any effect they may have depends upon their mechanical condition.

A bushel of average unleached hard wood ashes weighs about 48 pounds. This would contain

Potash	about 4 pounds,	worth	20	cents
Phosphoric acid	" 1½ "	"	3	"
Lime	" 18 "	"	7	"

Wet ashes are not much more compact than dry. A bushel of wet ashes weighs considerably more than a bushel of dry ashes, but this difference is chiefly due to the water. A bushel of wet or leached ashes contains about 50 pounds of dry matter or practically the same as a bushel of dry ashes.

Canada ashes as sold in car lots in this State carry from 3 to 7 per cent of potash, and would at the valuation thus used be worth from 18 cents to 28 cents a bushel. Average dump ashes at the same valuation will be worth about 13 cents, and average mill furnace ashes about 15 cents a bushel. In buying, the cost of carting and applying needs to be taken into account.

"Muck."

The correct use of the word muck, which means dung in a moist state, has been entirely lost in New England and is applied without much discrimination to any bog earth derived chiefly from decaying vegetable matter. The term as used includes materials ranging from a bog meadow mud to quite perfect peats. Large deep bogs containing true peat are comparatively few in New England, but small, shallow depressions, containing impure peats, occur everywhere. The gravelly soils of New

England need the addition of large amounts of organic matter and these impure peats have been thus used for generations under the general name of "muck." While the use of the word in this sense is provincial and perhaps not to be encouraged, it will be so used here for lack of a better term. By "peat" is generally understood a somewhat similar product in which the decomposition has not advanced so far. Such material is usually brownish in color and when dry has considerable fuel value.

These peaty soils or mucks are the results of the partial decay of vegetable materials. They are found in swampy places filled with stagnant water. The successive growth of sphagnum and other water-loving mosses, as well as the forest leaves falling into the water, are changed by decay into the black earths and impure peats. Mucks thus formed contain appreciable amounts of insoluble nitrogen and usually but little mineral matters, unless sand, clay or silt has been washed into them during their formation. Mucks owe their peculiar properties to this decomposed vegetable matter, which constitutes the *humus* of the agricultural chemist.

ANALYSIS OF MUCKS.

During the past few years the Station has examined for correspondents a number of samples of these materials from different parts of the State.

The following table shows the pounds of water contained in mucks as they are taken from the bogs, and the varying weights of ash, organic matter, nitrogen, phosphoric acid and potash contained in 100 pounds of the *water-free* (perfectly dry) mucks:

POUNDS OF WATER IN 100 POUNDS FRESH MUCKS AS TAKEN FROM THE BEDS AND THE POUNDS OF ASH, ORGANIC MATTER, NITROGEN, PHOSPHORIC ACID, AND POTASH IN 100 POUNDS OF PERFECTLY DRIED MUCKS.

Laboratory number.	Locality.	Water in fresh mucks.	In water-free material.		Phosphoric acid.	Potash.
			Organic matter.	Nitrogen.		
278	South Sebec	83.2	86.9	2.77	.17	.02
279	Turner	75.1	78.9	1.29	1.15	.07
280	Brunswick		96.2	1.98	.27	.17
281	New Gloucester		57.9	1.15	.26	.04
282	Freedom		65.4	1.51	1.97	.27
835	St. Albans	77.5	80.9	1.70	1.08	.14
841	Burkettville	80.7	92.3	2.16	.54	.08
842	Burkettville	79.5	65.6	1.67	.96	.20
218	Thomaston		57.2	2.06	.46	
219	Wayne		84.0	1.63	.13	
220	East Eddington		94.5	1.56	.11	
243	Charlotte	78.5	51.6	1.78	.28	.47
288	North Leeds	85.3		1.75		
3001				.68	.02	.06
3002	Readfield	86.8		1.86		
3065	Auburn			1.78		
3105	Richmond Corner	86.5		2.85	trace	trace
3106	Burnham			1.36	.22	.59
3107	Burnham			2.58	.34	.20
3165	Jackson			1.46	.44	.23
3166	Grange			1.19		.20
3167	Bar Harbor	80.7		1.26	trace	.90

POUNDS OF ASH, ORGANIC MATTER, NITROGEN, PHOSPHORIC ACID, AND POTASH IN 100 POUNDS OF DRY MATTER OF SUBSTANCES SOMEWHAT RESEMBLING MUCK IN APPEARANCE.

Laboratory number.	Kind of Material.	Ash.	Organic matter.	Nitrogen.	Phosphoric acid.	Potash.
221	Sea shore "muck"	22.7	77.3	.69	.16	.62
222	Decomposed sphagnum	.....	.....	.87	.....	.12
241	Mussel mud	.....	.....	.32	.16	1.06
3167	Mussel mud	.....	.....	.46	.59	1.43
593	True peat	18.1	81.9	.34	.....	.....
244	Drift on lake shore	.....	.....	2.07	.25	.19
395	Soil from dyked marsh	.....	.....	2.45	.24	.28

WATER IN MUCKS.

The large amount of water contained in this class of materials makes their handling laborious and expensive. When first shoveled out of the bed, more than three-fourths of the weight is due to the water. In the table it will be noted that the least water in 100 pounds of muck as taken from the bed was 75.1 pounds and in several cases there were more than 85 pounds of water in 100 pounds of the freshly shoveled muck.

It is never the case that mucks can be made perfectly dry in field or barn treatment. They are very retentive of moisture and even when shoveled out of the pit and allowed to remain in a heap until the dry season of the year, they still usually contain 40 to 50 per cent or more of water. If these materials are to be used as an absorbent in the stable, it is important that they be as thoroughly dried as practicable and kept protected from rains. One hundred pounds of well dried peaty muck will absorb 4 to 6 times its weight of urine.

ASH OR MINERAL MATTERS IN MUCKS.

The quantity of ash in these impure peats examined by the Station is variable but is usually large. In one instance only 5 per cent of the dry matter was ash, while in another sample 48

pounds out of 100 pounds of dry muck was ash. This ash is chiefly sand and has very little fertilizing value. On this account, therefore, the greater the amount of ash generally the poorer the muck. The quite complete analysis of the ash of five samples of muck follows. The laboratory numbers of the samples are the same as in the table on page 73.

POUNDS OF MINERAL MATTER IN 100 POUNDS WATER FREE MUCK.

	Sample number 278.	Sample number 279.	Sample number 280.	Sample number 281.	Sample number 282.
Sand, silica, etc.	.37	17.17	2.20	35.53	23.74
Iron oxide and alumina	.35	.....	.30	3.53	2.54
Lime	6.55	.72	.25	1.88	3.67
Magnesia	31	.....	.15	.15	12
Potash	.02	.07	.17	.04	.27
Soda	.30	.....	.17	.14	.03
Sulphuric acid	.70	.17	.10	.34	.82
Phosphoric acid	.17	1.15	.27	.26	1.97
Carbonic acid, coal, etc.	4.29	.....	.20	.20	1.45
Total ash	13.06		3.81	42.07	34.61

In the samples marked 278 and 280, the mineral matter probably consists for the most part of true ash—i. e., matter that once formed a part of the growing moss or other plants; although the large amount of lime in 278 may have come from the shells of minute organisms often found in shallow water. The large excess of mineral matter in the other samples must have proceeded from sand washed in from higher ground and is naturally poor in plant food.

ORGANIC MATTER AND NITROGEN IN MUCK.

From the above table and that on page 73 it is evident that whatever value mucks have as fertilizers is not due to the minute amounts of phosphoric acid and potash which they carry but to the organic matter and its accompanying nitrogen.

Mucks vary greatly in the organic matter which they contain. Occasionally a peaty muck will have as high as 95 pounds of organic matter for each 100 pounds of dry matter, while others will have little more than half that amount. Since the value of the muck as an absorbent depends upon its organic matter, it follows that for litter a peaty muck is better than one that is clayey or sandy.

The nitrogen in mucks is for the most part in inert compounds and is not immediately available for plant food. The quantity of nitrogen in mucks also varies greatly. With one exception the mucks examined at the Station carried more than 1 pound of nitrogen for each 100 pounds of water-free muck. Ten samples had about 2 pounds in 100 and 3 samples had more than 2½ pounds of nitrogen for each 100 pounds of dry matter. It is not a matter of indifference whether the muck is high or low in nitrogen content. While by far the larger part of the nitrogen in these materials is in a form that is insoluble in water and is, considered as a plant food, comparatively inert, it is a matter of common experience that this nitrogen may be made to contribute to the support of crops, and that it has therefore a considerable money value.

When muck is exposed to the action of the air, as when mixed with ordinary cultivated soil, its nitrogen slowly undergoes change and is gradually rendered available to the growing plant. Through the action of bacteria proper to soils the nitrogenous constituents in the humus are changed to ammonia. The most favorable conditions for this bacterial action are moisture, air and warmth and the absence of acidity. Hence the process of conversion of unavailable nitrogen compounds to available forms may be hastened by the addition of lime or ashes to a muck and by composting. The use of muck as a stable absorbent adds greatly to its store of nitrogen because of the nitrogen of the urine thus taken up, and the germs always present in manures accelerate the conversion of the inert nitrogen into available forms.

In the preparation of muck for manure as well as in consideration of preserving farm yard manure the question of composting naturally presents itself. While the ability to procure commercial fertilizers readily has caused composts to fall some-

what into disrepute,—and while in certain localities, near cities, it may be more profitable to expend labor in hauling stable manure than in building compost heaps—it is true of a State of small proprietors, for whose labor there is at times no profitable outgo, that "the composting of muck and peat with stable and barnyard manures is surely destined to become one of the most important items in farm management."

Some mucks ferment of themselves when thrown into heaps and such kinds serve well as manures without weathering, fermentation or any kind of preparation. But the kinds most common in Maine are well nigh useless as manures unless they have been rotted or fermented. In view of these differences it is not strange that farmers frequently deem mere exposure of muck to the air to be a sufficient preparation of this material. While this is the case with some mucks, the safest and surest way of obtaining good results with muck is to ferment artificially in the compost heap.

Experience teaches that in many situations, a large proportion of the useful ingredients of dung and urine can be saved by composting with muck. It is equally certain through such composting the unavailable plant food of the muck is made available. The ferments are present in such amounts in farm manures that left to themselves they suffer by the fermentation, and most mucks are so deficient in ferments that by themselves the fermentation necessary to render their inert organic matter available will not take place.

In the preparation of muck composts, dung or fish are the materials commonly used to excite fermentation. Most farmers prefer to make compost in heaps. A common plan is to lay down a bed of muck six or eight feet wide and a foot or so thick and cover it with a layer of dung of somewhat less thickness, followed by another layer of muck and so on. Different farmers use very different proportions of muck. The ordinary practice seems to vary from 1 to 5 parts of muck to 1 part of dung. Rich dung from stall-fed cattle will ferment more muck than that from animals less highly fed. The practical rule is to use no more muck than can be thoroughly fermented by the manure. In the case of sour muck the addition of small amounts of lime or wood ashes will correct the acidity and hasten fermentation.

Nitrogenous manures cost more than others for the simple reason that concentrated nitrogenous compounds capable of supplying this element to plants are neither abundant nor readily prepared. "New sources of phosphate of lime have continually been discovered, so that the price of this article has not risen from year to year, in spite of the greatly extended use of it. But the assimilable nitrogen compounds are more costly than either phosphates or potash salts, and there is no immediate probability that their price will be much reduced. Hence the importance of recognizing clearly the value of the peat (muck) and the humus which are found already in the fields." *

Seaweeds.

Seaweeds have long been used as manures in this country and in England. Here in New England there is abundant evidence of the great value of sea manure. According to Storer, with the exception of the intervale farms of the Connecticut river, the farms that depend upon manures derived from great cities, and a few localities in which the fertility is based upon fish manure, "the only really fertile tracts in New England are to be found back of the sea beaches upon which an abundant supply of seaweeds is thrown up by storms."

Under the name of seaweed are included a large number of plants which grow in the water on the coast and are found collected on the shelving beaches or in inlets, or adhering to the rocks covered by tide water. From their habit of growth, those which grow upon the rocks between low and high water mark are called rockweed. Others which grow in deeper water from low water mark out to a depth of four or five fathoms and are washed in by the tides are called driftweed or kelp. These materials are valuable agricultural resources to farmers located near tide water, but it is doubtful if the farmers along the coast of Maine fully appreciate their value and utilize them to the extent they should. They are used extensively on the coast of France, Germany, Great Britain, Ireland and southern New England and many fine farms owe their fertility almost wholly to these materials.

*Storer, Agriculture, Vol. II, p. 82.

SEAWEED AS CATTLE FOOD.

While their chief value is as a manure, some varieties of seaweeds are used as food and on some islands near the coast, sheep subsist largely upon them during the winter months.

Mr. H. A. Long of Roque Bluff has for many years been a successful grower of sheep on one of the islands of the Maine coast. During the present winter, agents for the Maine State Society for the Protection of Animals investigated the conditions under which the island sheep are kept. Three years ago Mr. Long sent samples of the kinds of rock weeds eaten by the sheep to the Station for analysis. Because of this and the investigation of the society above named, he recently wrote as follows:

"Are the elements found in the seaweed capable of sustaining life without any other food? We know that our sheep eat it in the winter and practically live on it for six or seven months in the year, and if it will keep them fat and strong, why is it that we must house our sheep and feed them hay and grain as we are told the law requires us to do? My cows will go to the shore nearly every day and eat some of the rockweed from the rocks, and I have never seen any hurt to them, or odor in milk. If possible I wish to have made plain to me the value of a pound of seaweed or rockweed, compared with a pound of good hay fed to a sheep or cow."

As the same question is of importance and interest to many in the state, the chief points given in the answer to Mr. Long are here presented:

The sample sent to the Station by Mr. Long was a mixture of several species of rockweed. They were separated into two lots and analyzed as two samples. The sample called rockweed consisted chiefly of two species of flat-stemmed rockweed, *Fucus vesiculosis* and *Fucus evanescens*. The other sample was sea lettuce. In the following table there is given the analyses of these samples, and for the purpose of comparison, there is also given the average analysis of a few common cattle and sheep fodders.

POUNDS OF WATER AND NUTRIENTS IN 100 POUNDS OF SEA WEEDS AS COLLECTED COMPARED WITH THE WATER AND NUTRIENTS IN 100 POUNDS OF COMMON CATTLE FODDERS.

	Water.	Protein.	Fat.	Fiber.	Nitrogen-free extract.	Ash.
Rockweed (Fucus)	73.9	2.8	.4	3.5	13.1	6.3
Sea lettuce (ulva).....	78.6	2.7	.2	2.2	5.7	10.6
Corn fodder (green).....	79.3	1.8	.5	5.0	12.2	1.2
Corn silage.	79.1	1.7	.8	6.0	11.1	1.4
Timothy grass.	61.6	3.1	1.2	20.2	11.8	2.1
Timothy hay.....	13.2	5.9	2.5	29.0	45.0	4.4
Rye fodder (green).....	76.6	2.6	.6	11.6	6.8	1.8
Red clover (green).....	70.8	4.4	1.1	8.1	13.5	2.1

It will be seen from the table that in composition these seaweeds compare very well as a food with either corn fodder, corn silage, or rye fodder. While there have been no experiments upon the digestibility of these materials, because of the small amount of woody matter (fiber) in the seaweeds, it is fair to assume that they would be more readily and completely digested than the ordinary cereal green fodders.

SEAWEED AS MANURE.

The Station has analyzed the two specimens above described with reference to the manurial value with the following results:

POUNDS OF WATER, ASH, NITROGEN, PHOSPHORIC ACID, AND POTASH IN 100 POUNDS OF SEAWEED.

	Water.	Ash.	Nitrogen.	Phosphoric acid.	Potash.
Rockweed (*Fucus*).....	73.9	6.3	.44	.12	.40
Sea Lettuce (*Ulva*).....	78.6	10.6	.43	.10	.40

The Rhode Island Experiment Station made quite a thorough study of the seaweeds of that state, and published the results in bulletin 21 of that Station, which is by far the best treatise on seaweeds and their use yet issued. The figures in the following table are derived from that bulletin. For the sake of comparison

the results of the analysis are all calculated to a water content of 80 per cent.

POUNDS OF NITROGEN, PHOSPHORIC ACID AND POTASH CONTAINED IN 100 POUNDS OF DIFFERENT SEA WEEDS CONTAINING 80 PER CENT WATER AND COLLECTED AT DIFFERENT SEASONS OF THE YEAR.

Kind of sea weed.	Time of year.	Nitrogen.	Phosphoric acid.	Potash.	Lime.
Ribbon weed, kelp or tangle	Winter	.38	.09	.57	.31
	Summer	.19	.07	.16	.65
Broad ribbon weed, broad leafed kelp, Devil's apron	Winter	.45	.12	.78	.57
	Summer	.27	.05	.13	.52
Round stalked rock weed	Winter	.27	.07	.57	.41
	Summer	.13	.06	.55	.45
Flat stalked rock weed	Winter	.40	.11	.48	.37
	Summer	.16	.08	.62	.37
Eel grass, grass wrack	January	.34	.03	.13	.64
	March	.56	.09	.46	.49
	Sept.	.22	.08	.42	.48

Both species of ribbon weed or kelp are common on the rocks of our coast at and below low water mark, and the round and flat-stalked rockweeds constitute at least three-fourths of the covering of the rocks and stones between tide marks. As seen from the table the plants gathered in the winter season are richer in fertilizer elements that those gathered in the summer. It would, therefore, seem advisable to collect seaweeds during the winter months and if not convenient to apply them at once to the fields, they could be stored in large heaps until spring.

On account of the large water content and consequent weight of seaweeds, transportation far inland is not profitable. A part of the water can be removed by spreading out thinly on the shore and allowing exposure to a hot sun for a few days, but it is a question whether this practice is economical on account of the increased labor involved, and if the material is leached by rains after it has become partially dried a part of the fertilizing element is lost.

In addition to the seaweeds proper which belong to the group of marine algae, the table includes the results of analyses of eel grass. Eel grass is not a true seaweed, but belongs to the pondweed family, a group of (mostly fresh water) aquatic plants. The seaweeds proper rapidly decompose so that their fertilizing constituents become speedily available, and as they have no power of absorbing liquids, there is no advantage in composting them, and they are best applied directly in the green state. This is not true of eel gress, which more nearly resembles straw. While chemical analysis shows it to have nearly as much nitrogen, phosphoric acid and potash as the seaweeds, it is only with difficulty that they can be made available. Storer says, "It will hardly rot anywhere, either in the ground, in the hog-sty, or in the manure or compost heap."

Seaweeds produce their chief effect the first season. This adds to rather than detracts from their value as a fertilizer, since when they can be obtained at all, they can usually be had one year as well as another, and can be applied annually.

The analyses show that seaweeds are not evenly balanced manures. They contain relatively considerable amounts of nitrogen and potash and but little phosphoric acid. Consequently land dressed for a long time with seaweed alone becomes exhausted in phosphoric acid unless a large excess of manure is added which would be wasteful of the nitrogen and potash. Excellent results have been obtained by using phosphates with these manures. Dissolved bone or acid South Carolina rock may be used, 300 to 500 pounds to the acre, with 20 to 30 tons of the fresh seaweed.

With most crops the best results are obtained by applying the fresh material in the spring and either plowing or harrowing it into the soil, but potatoes and some root crops, like the sugar beet, are said to be injured in quality by spring applications. This is probably due to the large amounts of chlorides of magnesia, sodium, etc., they contain, as it is well known that these substances have the effect of depressing the amount of starch in tubers and thereby impairing the quality. Farmers who make use of this material largely for a potato manure overcome this difficulty to a large extent by applying it to the fields in the fall before planting in the spring. In this way potatoes of much better quality, it is claimed, are grown than by applying the seaweeds at the time of planting.

In some localities seaweed is applied as a top dressing to mowing fields, but if applied fresh in the summer season care must be taken not to apply too thickly, as there is danger of killing out the grass, especially on new fields. Some farmers prefer composting for this purpose with stable manure in order to fine the material so that it will spread more evenly over the field. It is probable that the addition of acid South Carolina rock to the compost would greatly increase its value and aid in holding the ammonia. If the fermentation is carried very far, land plaster or muck should be spread over the heap to prevent ammonia from escaping.

Valued on the basis of commercial fertilizers, seaweeds are worth about $1.50 to $2.00 per ton, as gathered, for the plant food they contain. The humus resulting from the use of seaweeds is of additional value to old fields that have been long cultivated. In southern New England the round and flat-stemmed rockweeds are highly prized by farmers for raising corn, and they frequently pay 5 cents per bushel for it as it is cut from the rocks.

Seaweeds have in common with commercial fertilizers the advantage of freedom from weeds, the spores of fungi and the eggs of insects. Practical farmers in Rhode Island say almost unanimously, that potatoes grown on seaweed are smoother and freer from scab than those grown on stable manure.

BONE AS MANURE.

While the Station has in the sixteen years of its existence analyzed numerous samples of bone, its investigations have not added greatly to the knowledge of the value of bones as fertilizer. The Station is, however, in frequent receipt of inquiries relative to the value of bone meal as a manure, and because of these inquiries the following is written.

Bones owe their fertilizing value to the nitrogen and the phosphoric acid which they contain. If a bone is soaked for a long time in dilute muriatic acid, the mineral portion is dissolved and a tough pliable mass of the same shape of the original bone is left. This is the organic matter of the bone, composed chiefly of ossein, a nitrogenous material which by long boiling is changed into glue or gelatine. This organic matter makes up from one quarter to one third of the weight of the bone. If a bone is thoroughly burned in fire the organic matter is destroyed and there is left the bone ash. Bone ash is composed chiefly of phosphate of lime, together with a little carbonate of lime and phosphate of magnesia. Raw bone has, in addition to the mineral matter and the ossein, more or less of fats and oils and some water.

When bone or bone ash is treated with strong sulphuric acid, part of the lime is taken away from the bone phosphate of lime and new compounds are found. One of these new compounds is a phosphate of lime containing only one-third as much lime as did the original bone phosphate. The rest of the lime unites with the acid and makes gypsum or land plaster. In practice, if sufficient acid were used to change all the bone phosphate into acid phosphate, the resulting mass would be too pasty and unmanageable for making fertilizers. When less acid is added, part of the bone phosphate is changed into the acid phosphate, and part into still another compound which has two-thirds as much lime as the original bone phosphate. The acid phosphate

is soluble in water and makes the water soluble phosphoric acid of commercial fertilizers. While the other phosphate is not soluble in water, it is readily available to plants. This is the so-called "reverted" phosphoric acid. The water soluble and the reverted together make up the "available" phosphoric acid of commercial fertilizers. The original prosphate of lime becomes very slowly available as a plant food, while the acidulated phosphate is speedily and completely available. Most of the acidulated phosphate used in the manufacture of fertilizers is not obtained directly from bone, but from bone ash and bone black or from phosphatic rocks, which occur in South Carolina, Florida and other southern states. The acidulated phosphate from rocks is called "dissolved rock" while that from bone ash is called "dissolved bone black." While dissolved bone black commands a higher price than dissolved rock, there is no evidence that the acid phosphate prepared from bone ash is superior as a fertilizer to the acid phosphate from "rock." Bone ash which has not been acted upon by sulphuric acid has comparatively little value as a fertilizer.

BONE MEAL.

Bone meal differs materially from bone ash, because of the ossein (nitrogenous material) which it contains. When bone meal is buried in moist earth the flesh-like ossein putrifies and its nitrogen becomes available to the growing plant. In its decay the ossein helps somewhat to dissolve the bone phosphate of lime and renders it available. The rapidity of the decay of bone is largely dependent upon its fineness. The Connecticut Experiment Station has adopted an arbitrary scale upon which is based the trade valuations of ground bone. Meal that passes through a sieve of one-fifteenth inch mesh is called "fine" and that which will not so pass is termed "coarse." They value the nitrogen in fine bone and tankage at fourteen cents a pound and in coarse at ten cents. They rate phosphoric acid in "fine" bone and tankage at four cents a pound and in coarse at two cents.

Bone meal has been used for many years in England and Germany where its effects have been carefully studied. These investigations show that bone meal does its best "upon soils that are neither too light and dry nor too close and wet," and that it

is of little value on any soil unless the land is well drained and of open texture. Both air and moisture are essential to the fermenting of bone. According to Storer, "bone meal would doubtless answer a good purpose on land newly broken up, and rich in decomposing organic matters, provided the land was neither too stiff nor too dry. So, too, when other conditions are favorable, bone meal will be likely to do better on land full of refuse from a previous crop than on land that has been closely cropped. In New England, it was recognized long ago, by practical men, that bone meal should not be applied to dry soils. It is esteemed in this region, however, for light soils that are fairly moist."

STEAMED BONE.

For the purpose of feeding, raw bones are undoubtedly superior to steamed because of their higher content of ossein. Recent experiments seem to show that in temperate climates lightly steamed bone, even though it may contain two or three per cent less of nitrogen than raw bone, is of greater fertilizing value than raw bone meal. When bones are placed in a closed boiler and are submitted to steam pressure, the bone becomes not only so friable that it can be readily and cheaply ground, but the chemical character of the ossein left in it appears to be changed. Meal thus made decomposes readily in the earth and according to recent experiments in Germany acts as a quicker and more powerful manure than meal from raw bones. In the manufacture of glue, bone is sometimes treated for a long time with steam at high pressure and thus loses the larger part of its ossein. This bone may carry less than one per cent of nitrogen and approaches bone ash in composition and fertilizing value. The lightly steamed bone offered in the market is probably a better fertilizer for most Maine crops and soils than raw bone meal of equal fineness.

Bone meal is by many highly regarded because it is a slow acting fertilizer, and a single application will last for several years. In present practice slow acting fertilizers are not held in as much repute as formerly. The teaching of Voelcker on this point is coming to be more and more followed. "Greater permancy is no recommendation whatever, for the primary use of all manures is to enable us to grow not scanty but heavy

crops; not to deposit on the land fertilizers which may last for three or four years, but by prompt, efficacious action to render a quickly remunerative return from a moderate outlay." The chief objection to the use of bone meal is, indeed, the slowness with which it becomes available.

THE COMPOSITION OF BONE.

Raw bone usually carries nearly six per cent of nitrogen and a little less than twenty per cent of phosphoric acid. The Maine analyses of locally ground bone meals have been found to vary within not very wide limits. The nitrogen in these meals usually runs from about 3.75 per cent to 4.25 per cent and the phosphoric acid from about twenty-one to twenty-three per cent. The imported bone meals sold by manufacturers of commercial fertilizers will frequently run lower than this, but their composition can be ascertained from the guarantees which the manufacturers place upon the packages. The average bone meals as turned out in the Maine mills can be expected to carry about four per cent of nitrogen and about twenty-two per cent of phosphoric acid.

BONE MEAL AND WOOD ASHES.

As shown from the above composition, bone meal is not a complete fertilizer in that it contains no potash. The practice which is quite common in Maine of mixing bone meal with wood ashes is a good one, not only because the wood ashes supply the lack of the bone in potash, but help to render the nitrogen and phosphoric acid more quickly available. Just what changes take place when bone and ashes are mixed together, and kept moist, are not as clearly known as is the action of sulphuric acid upon bone phosphate. Probably the potash of the ashes tends to saponify the fat and bring more or less of the other organic matters into solution. If the fermentation goes on in a heap, precautions should be taken to prevent loss of nitrogen. The action of the ashes upon the organic part of the bones causes the mineral part of the bone to disintegrate to a greater or less extent. There is no evidence, however, that the phosphate of lime in the bone undergoes any chemical change because of the ashes, or that it is any more available to the plants, only so far

as it may have been made finer. This disintegration or the working down of the bone is undoubtedly important in rendering the mineral matters of the bone more available. A mixture of equal weights of ground, lightly steamed bone and good hard wood ashes would carry about two per cent nitrogen, ten per cent phosphoric acid, and three per cent of potash.

ANALYSES OF MISCELLANEOUS FOOD MATERIALS.

CHAS. D. WOODS and L. H. MERRILL.

During the past three years the Station has had occasion to make chemical analyses of quite a number of different kinds and classes of materials used as food for man. The specimens were received from various sources, and while the results of the analyses have been used for the specific purposes for which they were made, they are for the most part still unpublished. Because it is believed that the results are of quite general interest, they are here brought together and discussed.

EGGS OF DOMESTICATED FOWLS.

The compilers of Bulletin 28 of the Office of Experiment Stations of the U. S. Department of Agriculture (the Chemical Composition of American Food Materials) found that, while there had been many (90) analyses of hens' eggs, no other American eggs had been analyzed. Accordingly, at the suggestion of the Director of the Office of Experiment Stations, the following analyses of turkey, goose, duck, and guinea fowl eggs were made.

The turkey eggs (6387) were furnished by the Rhode Island Experiment Station and were thus described by the Director:

"The birds which yielded the eggs sent you for analysis by request of the Office of Experiment Stations were just 'turkey.' I presume they were descendents of bronze turkeys, but they were certainly not pure bred fowls. The eggs were laid rather late (October) which enabled us to send them at that time. They had free range and were apparently healthy, vigorous birds."

The goose eggs (6388) were from the Sunnyfield Poultry Yards, South Portsmouth, R. I.

The duck eggs (6390) were "from pure blood Pekin ducks," and the guinea fowl eggs (6391) "from the ordinary speckled breed." Both samples were furnished by the Maryland Experiment Station.

WEIGHTS OF EGGS, AND WEIGHTS AND PERCENTAGES OF SHELL (REFUSE), WHITE, AND YOLK AS PREPARED FOR ANALYSIS.

Kind of egg.	Station number.	Individual egg.	Weight as received.	Weight Boiled.				Shell (refuse).	White.	Yolk.
				Shell (refuse).	White.	Yolk.	Total.*			
			Grams	Grams	Grams	Grams	Grams	%	%	%
Turkey.....	6387	a .	109.6	12.2	62.2	32.4	106.8	11.4	58.3	30.3
		b ...	104.2	11.6	59.4	30.4	101.4	11.4	58.6	30.0
		c....	102.0	11.8	57.4	30.0	99.2	11.9	57.9	30.2
		d	106.4	11.4	61.4	30.6	103.4	11.0	59.4	29.6
		Avg.	105.5	11.7	60.1	30.9	102.7	11.4	56.5	30.1
Goose.....	6388	a....	195.6	23.6	101.8	66.6	192.0	12.3	53.0	34.7
		b...	190.4	24.6	98.0	64.0	186.6	13.2	52.5	34.3
		c....	171.0	24.4	89.6	55.4	169.4	14.4	52.9	32.7
		d....	191.0	23.8	98.4	66.4	188.6	12.6	52.2	35.2
		e....	194.0	24.4	100.4	67.2	192.0	12.7	52.3	35.0
		f....	200.4	24.0	102.8	69.2	196.0	12.2	52.5	35.3
		Avg.	190.4	24.1	98.5	64.8	187.4	12.8	52.6	34.6
Duck.....	6390	a....	66.2	6.6	34.0	22.6	63.2	10.4	53.8	35.8
		b....	67.6	7.0	35.2	23.2	65.4	10.7	53.8	35.5
		c....	72.6	7.6	37.0	25.0	69.6	10.9	53.2	35.9
		d ...	76.0	7.6	40.0	26.6	74.2	10.2	53.9	35.9
		Avg.	70.6	7.2	36.5	24.4	68.1	10.6	53.6	35.8
Guinea fowl	6391	a....	40.4	5.8	20.4	13.2	39.4	14.7	51.8	33.5
		b....	41.8	6.2	22.4	11.4	40.0	15.5	56.0	28.5
		c....	38.8	5.2	19.6	12.8	37.6	13.8	52.2	34.0
		d....	39.6	5.2	21.0	12.6	38.8	13.4	54.1	32.5
		Avg.	40.2	5.6	20.9	12.5	39.0	14.4	53.6	32.0
Hens'†.....	....	.....	.....	.....	.....	.....	.....	11.2	.....	.....

*The decrease in weight includes loss in preparation of sample, as well as diminished weight due to cooking.

† Average of 34 samples, page 53, Bulletin 28 of the Office of Experiment Stations.

WEIGHT OF NUTRIENTS AND FUEL VALUE OF 1 POUND OF EGGS.

Station number.	Kind of Eggs.	Refuse (shells).	Water.	Protein.		Fat.	Ash.	Fuel value per pound.
				Nitrogen × 6.25.	By difference.			
	White of eggs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Calo.
6387	Turkey eggs	.....	.867	.115	.125	Trace.	.008	325
6388	Goose eggs	.....	.863	.116	.129	Trace.	.008	330
6390	Duck eggs	.....	.870	.111	.122	Trace.	.008	315
6391	Guinea fowl eggs	.....	.866	.116	.126	Trace.	.008	325
	Hens' eggs *	.....	.862	.123	.130	.002	.006	.....
	Yolk of eggs.							
6387	Turkey eggs	.....	.483	.174	.176	.329	.012	1875
6388	Goose eggs	.....	.441	.173	.184	.362	.013	1975
6390	Duck eggs	.....	.458	.168	.168	.362	.012	1980
6391	Guinea fowl eggs	.....	.497	.167	.173	.318	.012	1800
	Hens' eggs *	.....	.495	.157	.161	.333	.011	.....
	Edible portion (white and yolk).							
6387	Turkey eggs	.....	.737	.134	.142	.112	.009	850
6388	Goose eggs	.....	.695	.138	.151	.144	.010	985
6390	Duck eggs	.....	.705	.133	.140	.145	.010	985
6391	Guinea fowl eggs	.....	.728	.135	.143	.120	.009	875
	Hens' eggs †	.....	.737	.134	.148	.105	.010	.....
	As purchased (including shell).							
6387	Turkey eggs	.138	.635	.116	.122	.097	.008	735
6388	Goose eggs	.142	.597	.115	.129	.123	.009	860
6390	Duck eggs	.137	.609	.115	.121	.125	.008	880
6391	Guinea fowl eggs	.169	.606	.112	.119	.099	.007	730
	Hens' eggs †	.112	.655	.119	.131	.093	.009	.....

* Average of 11 analyses, page 54, Bulletin 28, of the Office of Experiment Stations.
† Average of 60 analyses, page 54, Bulletin 28, of the Office of Experiment Stations.

PREPARATION OF EGGS FOR ANALYSIS.

The analyses were made in the usual way by the official methods. The samples were prepared for analysis as follows:

The eggs as received were weighed individually and then "hard-boiled." Upon cooling each egg was weighed. The shells, whites, and yolks of each egg were carefully separated and weighed. The shells were then rejected. The whites as well as yolks were chopped with a chopping knife and tray till the pieces were about the size of kernels of wheat. The samples were then weighed and partially dried at a temperature of 45° C. After partially drying the samples were weighed and ground in a mortar. No attempt was made to determine the lecithins which were largely included in the fats.

The detailed weights and the results of the analyses are given in the preceding tables.

There is a great similarity in the proportion of shell, white and yolk in the eggs of the different domesticated fowl. Roughly speaking, the shell makes up about one-ninth, the yolk one-third, and the white about five-ninths of the whole eggs. The white of the egg is nearly seven-eighths water. The solids of the white are practically all nitrogenous matters and are sometimes said to be pure albumen. The Connecticut State Experiment Station has made an extended investigation of the white of hens' eggs and finds that it consists of four different though quite closely allied albuminoids. The usual factor for protein (nitrogen multiplied by 6.25) is apparently too small, and the protein "by difference" is probably the more accurate. It will be noted that the white of the different kinds of eggs are practically alike in composition and fuel values.

While the yolks of different kinds of eggs differ rather more in composition than the whites they are still remarkably alike. The yolk is rather less than half water. The solids are more than three-fifths soluble in ether. This ether extract consists of the ordinary fats (palmitin, stearin, and olein) and a small amount of other materials. The yolk is very complex in composition and the classes of nutrients are only approximately separated in the usual food analysis. It will be noted the protein "by difference" and "by factor" are practically the same and that the fuel value varies with the fat content from 1,800 calo-

ries per pound in the guinea fowl eggs with 31.8 per cent of fat, to 1,975 and 1,980 calories per pound in the duck and goose eggs with 36.2 per cent fat.

Egg Substitutes and Dried Eggs.

Because of the high price at which eggs are sold at certain seasons of the year and because of the readiness with which eggs loose their freshness, many attempts to produce satisfactory egg substitutes have been made. Some of the so-called egg substitutes consist chiefly of starch. These here reported upon are of animal origin and correspond somewhat nearly to eggs in their composition with the exception that they contain much less water and more of solid matter.

Because of the small amount of water and the high protein content, evaporated eggs resemble the concentrated foods described on pages 100-107 beyond. That they are used in this way in large quantities is illustrated by the fact that in 1898 the manufacturers of LaMont's Crystallized Eggs shipped over 100,000 pounds, equivalent to 400,000 dozen eggs, to the South African miners.

Ovine, (6389) made by Munroe & Co., 100 Maiden Lane, New York City, "takes the place of fresh eggs in baking." The directions state that "one ounce of Ovine is equivalent to five eggs. Take the required amount of Ovine (one heaped-teaspoonful about equal to one egg) and sift well with the flour. The more even the mixture, the better it will work. Use an ample amount of baking powder or yeast. Work the dough well. Less butter is needed for shortening if Ovine is used in place of eggs."

From the analysis below it will be noted that Ovine resembles the white of egg much more nearly than it does the entire egg. It has practically no fat and consists chiefly of nitrogenous matter. The analysis does not in any way explain why the makers should claim that it takes the place of "shortening," i. e., fat, as it contains practically none.

LaMont's Crystallized Egg (6395 and U. S. Department of Agriculture, No. 20496) is manufactured by C. Fred LaMont, St. Louis, Mo. "Simply fresh eggs with the water expelled. Dissolves readily in cold or luke warm water or milk." "Not a substitute but guaranteed simply shell eggs desiccated." Egg

Flake (U. S. Department of Agriculture No. 20524) and Crystallized Egg each have a composition corresponding to dried eggs without the shell, and give every indication of being desiccated eggs as claimed.

WEIGHTS OF NUTRIENTS AND FUEL VALUE OF ONE POUND OF EGG SUBSTITUTES AS FOUND IN THE MARKET.

Laboratory number.	Name.	Water.	Protein.		Fat.	Ash.	Fuel value per pound.
			Nitrogen × 6.25.	By difference.			
		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Calo.
6389	Ovine	.114	.739	.792	.008	.091	2105
6395	Crystallized Egg (LaMont)	.075	.471	.554	.338	.033	2945
20486	Crystallized Egg (LaMont)*	.050	.486	.555	.356	.039	
	Crystallized Egg (LaMont)						
	Average	.062	.479	.555	.347	.036	
20524	Egg Flake*	.068	.452	.512	.385	.035	

*Analysis (unpublished) by the Chemical Division of the U. S. Department of Agriculture.

Prepared Flours.

After the publication of the analyses of cereal foods in Bulletin 55 of this Station, quite a number of inquiries were received relative to self-raising flours. While inquiry among the dealers gave evidence that these goods were not very greatly used in the State, it was thought best to obtain samples for analysis of the brands more commonly sold.

As acid phosphate is cheaper than tartaric acid and as alum is a low-priced adulterant of baking powder, the samples were examined for these materials. The description of samples and results of the analysis follow. Beyond the table a discussion of these materials is given.

6396. Aunt Jemima's Pancake Flour. R. T. Davis Mill Co., St. Joseph, Mo.

"Pure and healthful." "It is made of the three staffs of life." "Wheat, corn and rice."

6397. Uncle Jerry's New England Corn and Rice Pancake Flour. I. Pieser & Co., 130-132 Washington St., Chicago, Ill.

"In this preparation we use corn, potatoes, wheat and rice." "Formula 92¼% wheat, rice corn and potatoes, 2½% salt, 5¼% leavening."

6398. Uncle Jerry's New England Self-Raising Buckwheat Flour. I. Pieser & Co., 130-132 Washington St., Chicago, Ill.

"Compound: 70% buckwheat flour, 20% wheat flour, 10% corn flour, and sufficient seasoning and leavening."

6399. Reliable Self Raising Prepared Flour. Reliable Flour Company, Boston, Mass.

"This reliable flour is made from the choicest selected wheat." "An absolutely pure cream of tartar preparation."

6400. Hecker's Superlative Self-Raising Flour. Hecker-Jones-Jewell Milling Co., New York.

"Mixture of pure flour and wholesome phosphatic leavening materials." "These goods conform strictly to the pure food laws of Pennsylvania." "Mixture of wheat flour, phosphate, soda and salt."

6401. U-re-ka Self Raising Prepared Flour. Ureka flour Co., Portland, Maine.

"Mixed Flour. Made of wheat flour, pure grape cream of tartar, bi-carbonate of soda and salt."

6402. Purina Health Pancake Flour. Purina Mills, St. Louis, Mo.

"Made from Purina health flour (whole wheat), corn flour, salt and the leavening properties—phosphate and soda.

6403. Century Health Self-Raising Pancake Flour. Purina Mills, St. Louis, Mo.

"Made of health products only, consisting principally of gluten whole wheat flour."

6404. Cereal Pancake Flour. The Cream Cereal Company, Xenia, Ohio.

"Guaranteed a purely grain product." "Absolutely free from adulterations of any kind." "A pop corn product."

6405. Swan's Down Prepared Cake Flour. Ingleheart Bros., Evansville, Ind.

"Prepared strictly from the purest and best winter wheat." "This is not self-raising flour."

WEIGHT OF TOTAL AND AVAILABLE CARBON DIOXIDE, ALUM AND PHOSPHORIC ACID IN ONE POUND OF PREPARED FLOUR.

Laboratory number.	Name.	Total carbon dioxide.	Available carbon dioxide.	Alum.	Phosphoric acid.
		Lbs.	Lbs.	Lbs.	Lbs.
6396	Aunt Jemima's Pancake Flour	.0027	.0024	.....	.0079
6397	Uncle Jerry's Pancake Flour	.0055	.0045	.0084	.0083
6398	Uncle Jerry's Buckwheat Flour	.0056	.0037	.....	.0001
6399	Reliable S-R Prepared Flour	.0073	.0062	.0027	.0001
6400	Hecker's Superlative S-R Flour	.0065	.0056	.....	.0089
6401	Ureka S-R Prepared Flour	.0058	.0032	.....	.0010
6402	Purina Health Pancake Flour	.0072	.0052	.....	.0083
6403	Century Health S-R Pancake Flour	.0037	.0017	.0019	.0009
6404	Cereal Pancake Flour	.0048	.0042	.0022	.0003

WEIGHTS OF NUTRIENTS AND FUEL VALUE OF ONE POUND OF PREPARED FLOURS.

Laboratory number.	Name.	Water.	Protein (N × 6.25).	Fat.	Carbohydrates.	Ash.	Fuel value per pound.
		Lb.	Lb.	Lb.	Lb.	Lb.	Calo.
6396	Aunt Jemima's Pancake Flour	.089	.094	.006	.761	.050	1705
6397	Uncle Jerry's Pancake Flour	.090	.107	.007	.746	.050	1680
6398	Uncle Jerry's Buckwheat Flour	.091	.109	.012	.730	.058	1670
6399	Reliable S-R Prepared Flour	.080	.090	.008	.782	.030	1690
6400	Hecker's Superlative S-R Flour	.094	.091	.009	.758	.048	1650
6401	Ureka S-R Prepared Flour	.090	.069	.009	.787	.025	1710
6402	Purina Health Pancake Flour	.089	.100	.016	.738	.057	1670
6403	Century Health S-R Pancake Flour	.086	.099	.009	.750	.056	1680
6404	Cereal Pancake Flour	.080	.122	.028	.727	.046	1740
6405	Swan's Down Prepared Cake Flour	.098	.103	.008	.792	.002	1470

The chief variation of a self-raising flour from a typical flour of the same grade is found in its higher ash content. A pound of straight patent flour will have about .005 pounds of ash. The ash in 1 pound of the self-raising flours (6405 is not self-raising) varies from .025 to .058 pounds. This added ash consists of common salt, and leavening materials. Patent flour usually carries about .002 pounds of phosphoric acid to the pound. Larger amounts than this in a self-raising flour indicates that acid phosphate has been added in the leavening. The use of phosphoric acid in place of cream of tartar is perfectly proper and indeed on some accounts preferable. Alum should not be present in flour. In small amounts its presence may be accidental. When as much as .002 pound occurs in a pound it is fair to assume that it was added intentionally. Alum is harmful and should not be used in flours or baking powders.

The amount of leavening is measured by the carbon dioxide which is evolved when the flour is wet up with water and heated. As shown by the analyses the total leavening power may be considerably in excess of the available, the proportion of the latter decreasing with age. If chemical leavening agents are to be used, it is far better to mix them with the flour at the time of baking.

Good bread flour with sufficient cream of tartar and soda as leavening material costs about 3 cents a pound. The ready prepared flours here reported upon were sold at the rate of 5.3 to 16.1 cents per pound. Because of the high cost, the poor keeping quality and the temptation to adulteration, from the standpoint of economy and health, the general use of prepared self-raising flours is unwise.

Pea Flour.

A five pound package of pea flour sent by Dr. Charles Caldwell of Chicago to the Department of Agriculture was forwarded to the laboratories of this Station for analysis. Dr. Caldwell regards the flour as a very promising addition to our food products. He recommends that it be mixed with wheat flour and used for bread making, "since it not only improves the flavor of the bread, but its texture as well, the loaf remaining soft and moist much longer than when wheat flour alone is employed." He suggests that it be compressed into cakes and

used as an army ration. Its preparation is supposed to include steam cooking, roasting and reduction by the roller process. It is light sulphur-yellow in color and nearly as fine as ordinary wheat flour. Its composition is given in the following table, together with that of dried peas and wheat flour.

WEIGHT OF NUTRIENTS AND FUEL VALUE OF ONE POUND OF PEA FLOUR, DRIED PEAS, AND WHEAT FLOUR.

	Water.	Protein (N × 6.25).	Fat.	Carbohydrates.	Ash.	Fuel value.
	Lb.	Lb.	Lb.	Lb.	Lb.	Calo.
Pea Flour, 6430	.078	.284	.019	.587	.032	1884
Dried peas *	.095	.246	.010	.620	.029	1665
Wheat Flour †	.126	.117	.014	.738	.005	1763

* Bulletin 28, Office Experiment Station, p. 67.
† Average of 21 analyses made at this Station.

The pea flour is very rich in protein, containing nearly two and one-half times as much as wheat flour. If the product were placed upon the market at a moderate price it seems quite probable that it would find a ready use.

Gluten Foods.

In Bulletin 55 of this Station the analyses were given of several so-called gluten preparations which carried "only a little more protein and a little less carbohydrates than ordinary flour."

As a result of the publication of these analyses, we have received many letters from people suffering with diabetes asking for information relative to gluten preparations high in protein and low in carbohydrates. The Pure Gluten Food Company of New York claim that their goods are high in gluten and low in starch. These claims are substantiated by the analyses of samples which follow:

Breakfast Cereal Pure Gluten, (6342). The Pure Gluten Food Company, New York. "The Strength of the Wheat.

Gluten Breakfast Cereal is entirely free from starch and has received the highest medical endorsement for the treatment of diabetes, dyspepsia, obesity and Bright's disease. Gluten Breakfast Cereal is rich in nitrates and phosphates, the essentials in upbuilding and strengthening the tissues, muscles, nerves and bone. It contains none of the heating properties found in the cereals. It promotes perfect digestion."

Plain Gluten Flour, Pure Gluten, (6343). The Pure Gluten Food Company, N. Y.

"The ideal flour for diabetes, dyspepsia, obesity and Bright's disease. For making bread and crackers. Pure gluten flour is entirely free from starch and contains all the properties for muscle and fiber building. Our gluten preparations have received the highest medical endorsement. We invite comparison and chemical analysis."

Self-Raising Flour, Pure Gluten, (6344). The Pure Gluten Food Company.

"Pure Gluten Self-Raising Flour is the ideal preparation for making self-raising pancakes, muffins and gems. It contains all the nitrates or muscle and fibre producing qualities, and being entirely free from starch, it has none of the heating properties of other pancake flours, and will not therefore disturb digestion, nor produce derangements incident to warm weather. As a pancake or gem flour for diabetics and dyspeptics, it is incomparable in nutritive worth."

WEIGHT OF NUTRIENTS AND FUEL VALUE OF ONE POUND OF THE PURE GLUTEN FOOD COMPANY'S GLUTEN PREPARATIONS.

Station number.		Water.	Protein.	Fat.	Crude fiber.	N-free extract.	Ash.	Fuel value per pound.
		Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Calo.
6342	Breakfast Cereal	.093	.437	.016	.003	.444	.007	2060
6343	Plain Gluten Flour	.099	.536	.012	.002	.345	.006	2150
6344	Self-Raising Flour	.098	.315	.014	.063	.532	.038	1885

Condensed Foods.

Within a few years there has been placed upon the market a considerable number of condensed or concentrated foods, designed for the use of armies, or for explorers, sportsmen and others, to be used under conditions that render it desirable to reduce weight and space to the minimum. The constantly increasing number of these articles indicates a correspondingly increased demand. How far the want has been met can, to a certain extent, be determined by a study of the analyses recently made at this Station and here reported.

CONDENSED FOODS. DESCRIPTION OF SAMPLES.

Laboratory number.	Brands and Manufacturers.
6323	Ration Cartridge, Pea, Beef, etc., Bovril, Limited, London.
6324	Campaigning Foods, Blue Ration, Bovril, Limited, London.
	a Meat Albuminoids. b Chocolate Basis.
6325	Campaigning Foods, Red Ration, Bovril, Limited, London.
	a Meat Albuminoids. b Chocolate Basis.
6326	Ration Cartridge, Potatoes, Beef, etc., Bovril, Limited, London.
6327	Emergency Ration, Bovril, Limited, London.
	a Meat Extractive Basis. b Chocolate Basis.
6328	Emergency Ration, Bovril, Limited, London.
	a Concentrated Beef. b Cocoa Paste.
6321	Nao Complete Meat Food, The Military Equipment Stores and Tortoise Tents Co., London.
6322	Army Rations, Mutton and Vegetables, Maconochie Bros., London.
6332	Standard Emergency Ration, American Compressed Food Co., Passaic, N. J.
6333	Standard Emergency Ration, American Compressed Food Co., Passaic, N. J.
	a Tablet. b Chocolate.
6335	Arctic Food, Arctic Food Company, Minneapolis, Minn.
6334	Tanty Emergency Ration, Tanty Cuisine, New York City.
6341	F. A. F. Co's Beef-Vegetable Stew, Franco-American Food Co., Jersey City Heights.
6407	Toril Beef Tea, Toril Albumen & Extract of Meat Co., Altoona-Hamburg.
6306	Soson, Toril Albumen & Extract of Meat Co., Altoona-Hamburg, Germany.
6329	Tropon, Troponwerke, Mulheim-Rhein.
6429	Plasmon, American Syndicate, New York City.
6330	Pain-de-guerre.

A large proportion of the foods examined were of English manufacture and may be classed under the general head of "emergency rations"—i. e., rations that, without fully satisfying the needs of the body, may still enable the consumer to continue his active pursuits for a few days without an appreciable loss of strength. Of the other articles examined, 3 consist chiefly of proteids and are designed not as foods in the general sense, but rather as articles of dietetic therapy. The results of the analyses follow:

WEIGHTS OF NUTRIENTS AND FUEL VALUE OF ONE POUND OF CONDENSED FOODS.

Laboratory number.	Brand.	Water.	Protein.	Fat.	Carbohydrates.	Ash.	Fuel value per pound.
		Lb.	Lb.	Lb.	Lb.	Lb.	Calo.
6323	Ration Cartridge	.142	.219	.174	.407	.058	2016
6324	Blue Ration a.	.450	.222	.054	.224	.050	1160
6324	Blue Ration b.	.013	.072	.296	.601	.018	2536
6325	Red Ration a	.277	.215	.151	.310	.047	1843
6325	Red Ration b	.016	.064	.299	.605	.016	2497
6326	Ration Cartridge	.416	.220	.045	.270	.049	1237
6327	Emergency Ration a.	.122	.468	.246	.099	.065	2333
6327	Emergency Ration b.	.017	.072	.290	.602	.019	2497
6328	Emergency Ration a.	.037	.594	.269	.055	.045	2909
6328	Emergency Ration b.	.045	.065	.121	.747	.022	2099
6321	Nao Meat Food	.529	.130	.206	.106	.029	1378
6322	Army Rations	.636	.153	.128	.072	.011	1058
6332	Standard Emergency Ration	.056	.310	.216	.384	.034	2385
6333	Standard Emergency Ration a.	.063	.188	.203	.507	.039	2356
6333	Standard Emergency Ration b.	.010	.066	.214	.694	.016	2349
6335	Arctic Food.	.072	.178	.396	.283	.071	2606
6334	Tanty Emergency Ration	.660	.127	.102	.088	.023	910
6341	F. A. F. Co's Stew	.662	.155	.119	.054	.010	978
6407	Toril Beef Tea	.156	.423	.003	.164	.254	1009
6406	Soson	.064	.931	.002	.....	.003	2444
6329	Tropon	.082	.885	.003	.012	.008	2317
6429	Plasmon	.085	.750	.002	.089	.074	2044
6330	Pain-de-guerre	.106	.108	.005	.768	.013	1719

The samples of concentrated foods were all received through the Office of Experiment Stations of the U. S. Department of Agriculture. Capt. E. L. Munson, surgeon of the U. S. Army, was making investigations of concentrated foods on the market with the especial purpose of studying their adaptability for army purposes in the Tropics. As a result of his inquiry, he obtained the samples herewith reported which were forwarded here for analysis.

CONDENSED FOODS. WEIGHT OF PACKAGE AND CONTENTS.

Laboratory number.	Brand.	Weight of original package.	Weight of Contents.		
			Total.	a.	b.
		Grams	Grams	Grams	Grams
6323	Ration Cartridge, Pea, Beef, etc	320	241	.....	.....
6324	Blue Ration, Campaigning Food	340	247	169	78
6325	Red Ration, Campaigning Food	274	199	122	77
6326	Ration Cartridge, Potatoes, Beef, etc	382	283	.....	.....
6327	Emergency Ration	330	233	120	113
6328	Emergency Ration	319	248	121	127
6321	Nao Meat Food	588	437	.....	.....
6322	Army Rations	823	661*	.....	.....
6332	Standard Emergency Ration	540	418†	.....	.....
6333	Standard Emergency Ration	402	319	270	49
6335	Arctic Food	444	422	.....	.....
6334	Tanty Emergency Ration	585	475	.....	.....
6341	F-A Food Company's Stew	1151	964	.....	.....
6407	Toril Beef Tea	Broken package	.....	.....	.....
6406	Soson	Broken package	.....	.....	.....
6329	Tropon	245	224	.....	.....
6429	Plasmon	490	453	.....	.....
6330	Pain-de guerre	55	55	.....	.....

* Excluding 26 grams bone.

† Not including a tablet of tea, 18 grams, and two small boxes of pepper and salt, 6 grams.

CONDENSED FOODS. GRAMS OF NUTRIENTS IN PACKAGE.

Laboratory number.	Brands.	Net weight contents.	Weight of Materials in Package.					Total fuel value.
			Water.	Protein.	Fats.	Carbohydrates.	Ash.	
		Gms.	Grams	Grams	Grams	Grams	Gms.	Calo.
6323	Ration Cartridge	241	34.2	52.9	42.0	98.0	13.9	1071
6324	Blue Ration a	169	76.1	37.5	9.0	37.9	8.5	432
6324	Blue Ration b	78	1.0	5.6	23.1	46.9	1.4	436
6325	Red Ration a	122	33.8	26.2	18.5	37.8	5.7	496
6325	Red Ration b	77	1.2	5.0	23.0	46.6	1.2	424
6326	Ration Cartridge	283	117.9	62.3	12.6	76.4	13.8	772
6327	Emergency Ration a.	120	14.6	56.1	29.6	11.9	7.8	617
6327	Emergency Ration b	113	1.9	8.2	32.7	68.0	2.2	622
6328	Emergency Ration a.	121	4.5	71.8	32.6	6.7	5.4	776
6328	Emergency Ration b.	127	5.7	8.3	15.3	94.8	2.9	588
6321	Nao Meat Food	437	231.3	56.9	90.1	46.2	12.5	1328
6322	Army Rations	661	420.2	101.2	84.3	47.9	7.4	1542
6332	Standard Emergency Ration	418	23.6	129.6	90.5	160.3	14.0	2198
6333	Standard Emergency Ration a	270	17.0	50.6	54.8	137.0	10.6	1402
6333	Standard Emergency Ration b	49	.5	3.2	10.5	34.0	.8	254
6335	Arctic Food	423	30.7	75.1	167.3	119.8	30.1	2430
6334	Tanty Emergency Ration	475	313.5	60.2	48.6	41.9	10.8	1482
6341	F-A-F Company's Stew	964	638.0	149.2	114.5	52.5	9.8	2460
6329	Tropon	224	20.5	198.2	.7	2.7	1.9	1144
6429	Plasmon	453	38.7	339.8	.8	40.3	33.4	2041
6330	Pain-de-guerre	55	5.9	5.9	.3	42.2	.7	208

The six preparations bearing the mark of Bovril, Limited, 30 Farringdon St., London, are all put up in tin cans in the form of flattened cylinders with rounded ends. These vary in length from 4½ to 7 inches and are easily opened by means of the key attached. All contain dried meats, in most cases mixed with vegetables, the whole ground and compressed. Four of the tins are made with a compartment containing one or more cakes of chocolate wrapped in tin foil. The inscription upon one of these cans (6327) is here given in full:

"Emergency Ration. Field service. This ration is not to be opened except by order of an officer, or in extremity. It is to be carried in the haversack and produced at inspections, etc. The ration is calculated to maintain strength for 36 hours if eaten in small quantities at a time." (Upon one end of the can) "Basis Meat Extractives and Albuminoids. May be used dry with or without biscuits, or as a soup one-fourth part boiled for 15 minutes in one pint of water." (On the other end of the can) "Chocolate Basis. The contents may be used dry, or one-fourth boiled in one pint of water. Bovril, Limited, London."

The Bovril goods, the Standard Emergency Rations, and Arctic Food may for convenience be classed together. It may be said of them all that they appear to be good articles and when prepared according to directions would probably furnish appetizing dishes, subject, of course, to the limitations common to all canned goods. The emergency rations 6327 and 6328 are "calculated to maintain strength for 36 hours if eaten in small quantities at a time." No direct claim of the kind is made for the other Bovril goods, though the statement that the Red Ration Cartridge (6323 and 6325) is "recommended to be used on alternate days with the Blue Ration Cartridge" (6324 and 6326), seems to imply that each of these cartridges is sufficient for a day. The package containing the Standard Emergency Ration, 6332, is said to contain "enough palatable food and drink to sustain one man for one day under all conditions." The Standard Emergency, (6333), is said to be sufficient for two hearty meals. These claims may very properly be considered here.

Various estimates have been made as to man's daily needs. These estimates have been based either upon a study of the daily waste of the body, or upon direct nutrition experiments, in which the daily food has been gradually reduced until a maintenance ration has been struck. While these estimates must vary not only with the individual, but with the habits and other conditions of the subject, an average may be fixed upon which is sufficiently exact for our present purposes. Of the standards given, those of Moleschott in Germany and Atwater in this country are perhaps as frequently quoted as any.

Moleschott gives the following diet as sufficient for a man performing a moderate amount of work:

Protein	120 grams.
Fats	90 grams.
Carbohydrates	330 grams.

This gives a total weight of 540 grams, or about 1 1-5 pounds of dry matter per day. By the use of the proper factors, we find that such a diet has a fuel value of 2,680 calories. That is, these quantities of nutrients, in the metabolic processes which they undergo in the body, yield an amount of heat sufficient to raise 2,680 kilograms of water 1° C., or about 5 tons of water 1° F.

It is an interesting fact that what constitutes an adequate diet for the European does not satisfy the American workman. By a study of dietaries in this country Atwater has found that a man at moderate labor requires daily about 125 grams proteids, with enough fats and carbohydrates to bring the fuel value up to 3,500 calories, an advance of about 30 per cent over Moleschott's estimate. This required fuel value may be supplied by adding to the 125 grams proteids, 100 grams fats, and 502 grams carbohydrates. In the following table these European and American estimates are compared.

	EUROPEAN.		AMERICAN.	
	Grams.	Calories.	Grams.	Calories.
Protein	120	492	125	512
Fats	90	837	100	930
Carbohydrates	330	1353	502	2058
Total	540	2682	727	3500

In the following tables these standards are compared with the contents of the packages concerning which the previously mentioned claims are made. Since 6327 and 6328 are said to be sufficient for 36 hours, two-thirds of the contents of the package are taken as the basis for calculation. The emergency ration 6333 is said to suffice for two meals; in the table the contents are therefore increased by one-half to correspond with one day of three meals.

DIETARY STANDARDS COMPARED WITH CONDENSED FOOD RATIONS

Laboratory number.		Protein.	Fats.	Carbohydrates.	Calories.
		Grams.	Grams.	Grams.	
	European Standard	120.0	90.0	330.0	2682
	American Standard	125.0	100.0	502.0	3500
6327	Emergency Ration	42.9	41.5	53.3	780
6328	Emergency Ration	53.4	31.9	67.7	793
6323	Red Ration	52.9	42.0	98.0	1009
6325	Red Ration	31.2	41.5	84.4	860
6324	Blue Ration	43.1	32.1	84.8	823
6326	Blue Ration	62.3	12.6	76.4	686
6332	Standard Emergency Ration	129.6	90.5	160.3	2030
6333	Standard Emergency Ration	80.7	98.0	256.5	2294

The comparisons made in the table show that for the most part the claims are extravagant. With the exception of the two last given, none of the packages supply more than one-half the protein required to replace the waste of one day, and not more than one-fourth or one-third of the potential energy called for by the standards. Indeed a little thought would have shown that no ration containing less than one and one-half pounds of dry matter can supply the waste of the active adult human body. If we refer once more to the standards given, we will see that even if a food could consist of absolutely pure protein, fats and carbohydrates, it must contain from 540 to 727 grams, or from one and one-fifth to one and three-fifths pounds. In practice such a food is impossible. In addition to the water and waste matters invariably present, there will always be a varying amount of mineral salts in our food, a certain proportion of which is just as essential to our existence as any one of the three nutrients already considered. While an amount of food under one and one-half pounds may constitute a valuable "emergency ration," the continued use of such a diet must inevitably result in a reduction in strength and body weight.

The Pain-de-guerre is an evaporated bread used as a concentrated ration in the French army. The process of manu-

facture is secret. The sample as received consisted of a single biscuit, about 2½ inches long and 1 inch thick, weighing less than two ounces (55 grams). It is said when it is moistened the Pain-de-guerre takes up a great deal of water and swells so that it has the appearance of soft bread rather than that of a cracker. Because of the smallness of the sample, this property was not tested. Its chemical analysis would seem to indicate that it is made entirely of wheat with which it agrees quite closely in composition.

Malted Nuts.

Malted Nuts. (6178). Manufactured by the Sanitas Nut Food Co., Ltd., Battle Creek, Mich.

"A perfect food, can be used to the exclusion of all other foods for infants or other persons, is suited to all ages and possesses all the essentials of a perfect nutrient. Malted nuts is not a chemical mixture of food elements, but a simple preparation of natural products, predigested and otherwise prepared for prompt and perfect assimilation."

As shown below, the claimed analysis on the wrapper corresponds closely with the results of the analysis of the sample here reported upon.

WEIGHT OF NUTRIENTS AND FUEL VALUE OF ONE POUND OF MALTED NUTS AS CLAIMED BY THE MANUFACTURERS AND FOUND BY ANALYSIS.

Claimed Analyses.	Lbs.	Analyses here Reported.	Lbs.
Water	.045	Water	.026
Vegetable Albumin	.236	Protein	.237
Nut fat (perfectly emulsified)	.204	Fat	.276
Digested starch (Maltose, etc.)	.493	Carbohydrates	.439
Salts	.022	Ash	.022
		Fuel value, Calories per pound	2,600

Acorns (*Quercus*).

In Bulletin 54 of this Station, Nuts as Food, there were given the results of analyses of acorns from the common black oak of Arizona, *Quercus Emoryi,* and samples of acorn meal and acorn bread used by the Indians of the Yosemite Valley as food. We were indebted to Dr. Chestnut of the Division of Botany, U. S. Department of Agriculture for these samples. In April, 1900,

Dr. Chestnut sent us specimens of the "Valley White Acorn," *Quercus lobata*, "one of the acorns which is most abundantly used by the Indians of Mendecino county, California." This is analyzed as number 6312. In shelling the nuts it was found that about half of them were spoiled. The edible portion of good ones made up the sample taken for analysis, but the proportion of shell (refuse) to kernel (edible portion) is based upon all of the acorns, good and poor.

Weight of acorns, 130 grams.
Edible portion, kernels, 93 grams, 71.54 per cent.
Refuse, shells, 37 grams, 28.46 per cent.

The composition is given below together with that of the acorns previously analyzed: It will be noted that the acorns of *Quercus lobata* are much lower in fat content and higher in carbohydrates than the other samples examined. This affects the fuel value markedly, as the fats have much greater heats of combustion than the carbohydrates.

WEIGHT OF NUTRIENTS AND FUEL VALUE OF ONE POUND OF ACORNS, ACORN MEAL, AND ACORN BREAD.

Laboratory number.		Refuse.	Water.	Protein.	Fat.	Total carbohydrates.	Ash.	Fuel value per pound.
6312	Acorn, Q. lobata,	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Calo.
	Edible portion	-	.075	.052	.086	.763	.024	1930
	As purchased.....	.285	.054	.037	.061	.546	.017	1380
6193	Acorn, Q. Emoryi,							
	Edible portion	-	.041	.081	.374	.480	.024	2720
	As purchased.....	.356	.026	.052	.241	.309	.016	1750
6184	Acorn meal	-	.087	.057	.186	.650	.020	2265
6185	Acorn bread.....	-	.603	.022	.069	.270	.006	2345

Italian Chestnuts.

These nuts were purchased in Boston and were used in digestion experiments. During the process of drying, a few of the nuts moulded, giving an unusually large proportion of bad nuts. Five kilograms gave:

Kernels, 3832 grams, 76.64 per cent.
Shells, 472 grams, 9.45 per cent.
Bad Nuts, 696 grams, 13.91 per cent.

The chemical composition is shown in the following table, to which is added for comparison two analyses of Italian varieties grown in California:

WEIGHT OF NUTRIENTS AND FUEL VALUE OF ONE POUND OF ITALIAN CHESTNUTS.

	Shells.	Water.	Protein.	Fat.	Carbohydrates.	Ash.	Fuel value.
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Calo.
Edible portion,							
Maine Station, 6393.....	-	.449	.089	.021	.477	.014	1075
California grown *	-	.538	.066	.020	.369	.007	-
California grown *.....	-	.527	.041	.020	.404	.008	-
As purchased,							
Maine Station, 6393.....	.094	.407	.035	.019	.432	.013	974
California grown	.154	.455	.056	.017	.312	.006	-
California grown	.155	.445	.035	.017	.341	.007	-

*Calif. Experiment Station, Report 1896-7, p. 153.

Three Tropical Fruits.

The Division of Pomology of the U. S. Department of Agriculture has furnished the Station with specimens of three little used tropical fruits, the cultivation of which is being introduced into the subtropical portion of the United States by the Department of Agriculture. The description of the fruits and the uses to which they are put are furnished by Mr. William Taylor, Pomologist in charge of Field Investigation of the Department.

SURINAM CHERRY,

Sometimes called Pitanga. 6313. This is the ribbed, roundish, oblate fruit of *Eugenia Michelii.* It is a tropical shrub, native to Brazil and other tropical portions of South America, attaining a height of about 20 feet. It is sparingly grown in Southern Florida and Southern California, where the fruits are esteemed for their sharp but pleasant acid flavor. They are somewhat used in domestic jelly-making, but the product has not yet attained commercial recognition,—at least in this country.

The samples analyzed were grown at Rockland Grove, Lemon City, Florida.

Weight of cherries, 140 grams.	
Edible portion, 116 grams,	82.86 per cent.
Stems and stones, 24 grams,	17.14 per cent.

WEIGHTS OF NUTRIENTS OF ONE POUND OF SURINAM CHERRIES.

	Water.	Protein.	Carbohydrates.	Ash.
	Lb.	Lb.	Lb.	Lb.
In fresh pulp	.850	.004	*.139	.007
Edible in one pound whole fruit	.704	.003	.115	.006

* Including invert sugars, .100 pound; total sugars, .101 pound.

AVOCADO,

Also known as Aguacate, Alligator Pear and Mid-Shipman's Butter. 6282.

This interesting fruit,—*Persea gratissima* of botanists—is the product of a tree native in tropical America, but now widely grown throughout tropical countries. The principal commercial supply in the markets of the United States comes from Jamaica, though there is a considerable and increasing production in Southern Florida, both on the mainland and the keys, and a small production in the milder portions of Southern California.

The West Indian type of the species—which is the only one found in our Eastern markets—yields a fruit as large as our

largest pears. The varieties differ considerably in form, and range from deep purple to light green in color.

The principal use to which this fruit is put is that of salad making. The soft buttery substance of the fruit lends itself to this use admirably. The Mexican type which is now being tested in both Florida and California, yields a much smaller fruit, but the tree is reputed to endure several degrees of frost, whereas the tree of the West Indian type is injured by a temperature of 32 degrees. The Mexican type is also reported to be of more dwarfish habit than the West Indian, the latter becoming a tree of large proportions.

The specimens analyzed were grown at Cocoanutgrove, Florida. Three pears were received, representing three distinct varieties. The pulp of the pears was mixed and analyzed as one specimen.

Weight of three fruits, 1,021.6 grams.

Edible portion,	762.2 grams,	71.09 per cent.
Seeds,	201.4 grams,	19.71 per cent.
Skins,	94.0 grams	9.20 per cent.
	1,021.6	100.00

WEIGHTS OF NUTRIENTS AND FUEL VALUE OF ONE POUND OF ALLIGATOR PEAR.

	Water.	Protein.	Fat.	Carbohydrates.	Ash.	Fuel value per pound.
	Lb.	Lb.	Lb.	Lb.	Lb.	Calo.
In one pound of edible portion.....	.811	.010	.102	.068	.009	1758
Edible in one pound of whole fruit....	.576	.007	.073	.049	.006	

ROSELLE,

Also known as Jamaica sorrel, 6394,—the *Hibiscus Sabdariffa* of botanists—is a widely distributed tropical plant yielding the Roselle fiber of commerce. As grown in Florida and California it is an herbaceous annual. It is valued in both states for its fleshy, acidulous calyces from which jellies and preserves are made that are of a beautiful wine-red color and have

a flavor approaching that of the cranberry. The plants are grown from seed planted in the spring and they require a long season free from frost to mature the crop. Under favorable conditions they produce a very heavy, continuous crop of blossoms in the latter part of the summer and autumn. The thick, juicy, dark red calyces are the only portions used, and these are at their best soon after the petals fall. If the harvest is long delayed, the enlarging ovary forms too large a proportion of the product and lessens its value by detracting from the acidulous flavor of the jelly or preserves.

The specimens examined were from Oneco, Manatee Co., Florida. The pod and calyx were analyzed separately. Extracts from both pod and calyx were also analyzed. 125 grams of the pods with the enclosing calyx gave:

Pods, 63.1 grams,	50.48 per cent.
Calyx, 61.9 grams,	49.52 per cent.

WEIGHTS OF NUTRIENTS AND FUEL VALUE OF ONE POUND OF JAMAICA SORREL.

	Water.	Protein.	Fat.	Carbohydrates.	Ash.
	Lb.	Lb.	Lb.	Lb.	Lb.
Calyx	.865	.021	.003	.103	.008
Pod	.840	.017	.010	.122	.011
Extract from calyx	.912	.009	.....	*.072	.007
Extract from pods	.887	.015	.....	†.042	.007

* Including sugars, .016 lb. † Including sugars, .010 lb.

THE HORTICULTURAL STATUS OF THE GENUS VACCINIUM.

W. M. MUNSON.

The members of the genus Vaccinium, though indigenous to this country, and supplying in large quantities fruit which is surpassed in quality by but few of the more generally cultivated species, have received comparatively little attention from horticulturists. In 1898 a report upon the Blueberry in Maine was published by the Maine Experiment Station. The object of the present paper is to present as concisely as may be the exact status of the group at the close of the nineteenth century, and if possible to extend the knowledge of these plants in such a way as shall insure a more just appreciation of their horticultural value.

There is much confusion in the vernacular names applied to members of the genus Vaccinium. The terms "Bilberry," and "Whortleberry" usually mentioned as "common names" by American writers, are seldom or never heard among the common people in this country, while "Huckleberry" is often used indiscriminately for plants of this genus and for the Gaylussacias. In the central states the term Huckleberry is usually applied to *Vaccinium corymbosum,* while Blueberry is given to the low growing species like *Canadense* and *Pennsylvanicum.* In New England, Huckleberry is reserved for species of Gaylussacia, while Blueberry is applied to the lower growing species as above, and High-bush Blueberry to *corymbosum.* There is no satisfactory explanation of the word huckleberry, which in English works occurs only in those of recent date.[1] The red berried species are, in general, referred to as cranberries.

[1] The Latin writers of the middle ages generally referred to plants of the genus Vaccinium as *Myrtillus*, and the fruit was known as myrtleberry. It is not improbable that the term Whortleberry is a corruption from myrtleberry (Cf. Prior, Pop. Names, Brit. Plts. 121) and that the American colonists further changed the name to "hurtleberry." The transition from hurtleberry to huckleberry was easy by simply dropping the first r, i. e., hutleberry. Others derive the name Whortle berry from the Anglo-Saxon *heort-berg*, hart-berry, or as we would say, deer-berry The question is discussed by Sturtevant in the Transactions of the Massachusetts Horticultural Society, 1890, p. 18.

In England the common names, as collated by Sturtevant, are: Whorts or Whortleberries and Bilberries; in France, Airelle, Aurelle, Myrtilles, Myrtilles des bois, Bluete; or in Brittany Lucets, and in Normandy Mawrets. In Sweden they are called, in Upland, Blabar; in Smoland, Slinner; in Scania, Bollion; in Lapland, Zirre and Zerre. In Brabant the usual terms are, Crakebesein, Haverbesein and Postelbesein; in Germany, Heydelbeeren, Bickbeeren, Blawbeeren, Schwartzbeeren; or for some species, Drunkelbeeren, Rauschbeeren, Grosse Heidelbeeren, Moosheidelbeeren, etc.; in Italy, Myrtillo; in Russia, Ticherniza, Pjaniza, Goluble, etc.[1]

DISTRIBUTION.

The genus includes about 125 species of wide geographic distribution, extending from the Arctic circle to boreal sub-tropical regions, and the high mountains of the tropics; most common in North America and the Himalayas. There are in North America proper about twenty-five species and in Mexico and Central America as many more. The Himalayan region is particularly rich in species many of which are epiphytic. With very few exceptions (e. g. *erythrinum* in Java and *emirnense* in Madagascar) the genus is unrepresented in the southern hemisphere and in the lower regions of the tropics.

The most widely distributed species are, perhaps, *Myrtillus* and *uliginosum,* which occur in middle and northern Europe, Asia (except in the central part from the Himalayas to Thianschan, where all vacciniums are absent), Canada and central North America southward to New York and Colorado, and westward to Alaska. *Uliginosum,* especially, is confined to northern and mountainous regions. *Vitis-Idæa,* also, has a wide distribution somewhat similar to *Myrtillus.* It is common in the higher woodlands and mountains of middle and southern Europe, in America southward to New England, Lake Superior and British Columbia.

In several places in Germany, as stated by Drude,[2] wild hybrids between the foregoing species and *V. intermedium,* Ruthe, are not uncommon. The hybrids have evergreen foliage.

[1] Sturtevant, Trans. Mass. Hort. Soc., 1890, 18.
[2] Eng. and Prant. Pflanzenfamilien, 4:51.

Though *erythrocarpon,* of the southern Alleghanies, is not found in the old world, a very closely allied species, *Japonicum,* is found in central Japan and China—these two species forming a unique type intermediate between the blueberries and the cranberries. In Japan Vaccinium is numerous in species, but, with the exception of the red fruited *V. Japonicum* and the black fruited *V. ciliatum,* they are not very abundant and are mostly confined to alpine summits where the species are found which in the extreme north encircle the earth; and blueberries nowhere cover the forest floor with the dense undergrowth which is common in our northern woods.[1]

Of the purely American species, the most important ones are: in the East, *cæspitosum, Canadense, corymbosum, Pennsylvanicum and vacillans,* together with the cranberries, *macrocarpon, Oxycoccus* and *Vitis-Idæa;* in the South, *Myrsinites* and *virgatum;* in the Northwest, *myrtilloides* and *ovalifolium.*

HISTORICAL NOTES.

The vacciniums have been strangely overlooked alike by horticulturists and by historians. Pliny, Vergil and Theophrastus make brief reference to them; Dodoens,[2] in 1578, and Gerarde[3] and Parkinson in the early part of the seventeenth century give brief discussions of several forms. Parkinson says:[4] "There are divers sorts of these low shrubs which must all go under the name of Whorts or Whortleberries, although there is much difference between them." He then describes nine different sorts, the first two being referred to as "Bilberries."

In America the fruit must have been used extensively by the Indians in colonial times, though there are few records of such use. Parkinson refers to Champlain who in 1615 found the Indians near Lake Huron gathering blueberries for their winter store. Kalm speaks of the Indians drying the fruit by the sunshine or by the fireside for winter use. Roger Williams mentions: "Attitaash (Whortleberries) of which there are divers sorts; sweet like currants.... Sautaash are these currants

[1] Sargent, Gard. & For. 6:254.
[2] Lyte's Dodoens, 670. (1578)
[3] Herballe, ed. 2, 1418. (1633)
[4] Theatrum Botanicum, 1459. (1640)

dried by the natives and so preserved all the year; which they beat to powder and mingle it with their parched meal, and make a delicate dish which they call Sautauthig, which is as sweet to them as plum or spice cake to the English."[1]

Until very recently no attempt has ever been made at improvement by cultivation.

USES OF THE FRUIT.

As before noted, the records concerning the uses and distribution of the vacciniums are meagre. Enough is known, however, to indicate that from the earliest times various species have been recognized as of value for food or ornament. Pliny[2] mentions the use of *vaccinia* to dye the garments of bond-slaves to a purple color.

Dodoens, in 1578, says:[3] "With the juyce of them (especially of the black kinde) is made a certayne medicine called of the apothecaries *Rob,* the which is good to be holden in the mouth against great drieth and thirst in hoat agues.....Fen or Marrische (marsh) Whortes doe also quenche thirste, and are good against all evil inflammation or heat of the blood."

Gerarde also, in 1633, writes:[4] "The juice of the black Whortleberries is boyled till it become thicke and is prepared or kept by adding honey or sugar unto it: the apothecaries call it *Rob,* which is preferred in all things before the raw berries themselves.....They be goode for a hot stomacke, they quench thirst, and allay the heate of burning agues.....The people of Cheshire do eat the blacke Whortles in creame and milke as in these south parts we eat strawberries.....The Red Whortle is not of such a pleasant taste as the blacke, and therefore not so much used to be eaten; but they make the fairest carnation color in the World."

Parkinson, in 1640, quotes Gerarde concerning the medicinal value of the "bilberries," and says further:[5] "With the juyce of the berries Painters do color paper or cards, doe make a kind

[1] Roger Williams' Key, 231; cited by Tuckerman, foot note in Josselyn's N. E. Rarities, 92.

[2] Lib. 16 cop. 18, cited by Gerarde, Herballe, ed. 2, 1419.

[3] Lyte's Dodoens, 670.

[4] Herballe, ed. 2, 1419.

[5] Theatrum Botanicum, 1459.

of purple blew colour, putting thereto some allome and Galles, whereby they can make it lighter or sadder as they please. And some poor folkes, as Tragus sheweth, doe take a potfull of the juyce strained whereunto an ounce of Allome, foure spoonfulls of good Wine vinegar, and a quarter of an ounce of the waste of the copper forgings, being put together, and boyled all together, they put their cloth, wooll, thred, or yarne therein, letting it lye for a good while, which being taken out and hung up to dry and afterwards washed with cold water will leave the like Turkie blew colour, and if they would have it sadder they put thereto in the boyling an ounce of broken Galles."

As already noted, the most widely distributed member of the group is *V. Myrtillus,* and this species is very generally used as an article of diet or in making drinks. In the Orkneys the fruit is large and is used for wine.[1] The Scotch Highlanders eat the berries in milk and "make them into tarts and jellies, which last they mix with their whiskey to give it a relish to strangers."[2] In England they are found in the markets and "are eaten in tarts or with cream or made into jelly,"[3] while in Poland, "mixed with wood strawberries and eaten with new milk they are considered a great delicacy."[4] In France they are esteemed as a fruit and are used for coloring wine.[5]

The berries are also of considerable importance for food in Germany, Siberia, and with the Indians of the Rocky Mountains.

V. uliginosum, after *Myrtillus* the most widely distributed species, has large, juicy, black fruits, which are eatable but not agreeable in flavor as ordinarily found, and are commonly believed to be unwholesome. Gmelin reports their extensive use in Siberia, though there they are believed to promote intoxication. It is probable, as is known to be the case with *V. Vitis-Idæa,* that in the far North the quality is better than further south. The western Eskimos, according to Seeman, collect the berries and freeze for winter use.[6] Of the species, Loudon says:[7] "In France they are used to color wines red; and in

[1] Dickson, Pr. Essays Hort. Soc., ser. 2, 7:132, cited by Sturtevant, l. c.
[2] Lightfoot, Fl. Scot. 1:201, cited by Sturtevant, l. c.
[3] Loudon, Arb. et Fruit. 2:1157.
[4] Ibid, 1158.
[5] Aspelin, Fl. Oecon. 520 (1784) cited by Sturtevant, l. c.
[6] Sturtevant l. c.
[7] Loudon, Arb. et Fruit. 2:1158.

Siberia and Sweden they furnish an ardent spirit that is highly volatile and intoxicating. The leaves are added to *Lycopodium alpinum* by the Icelanders; and a yellow dye for coloring woollens is produced by an infusion of the two plants."

Of *Vitis-Idæa* Loudon says:[1] "The berries are scarcely to be eaten raw, but they are made into pies in Derbyshire, and in Sweden a rob or jelly is made from them which is eaten with all kinds of roast meat. In Sweden this preserve is also considered an excellent medicine in colds, sore throats, and all irritations of the mouth or fauces. In Siberia the berries are macerated during the autumn and part of the winter in water; and afterwards they are eaten in a raw state, and fermented along with barley or rye, and a spirit distilled from them; or with honey, and a wine produced. Sweetmeats are also made of them with honey or sugar, which in 1814 we found in frequent use at Moscow at balls and masquerades. The berries of this plant form an important article of commerce in the sea ports bordering the Gulf of Bothnia, whence they are sent to the south of Europe along with cranberries."

In the colder parts of North America, and along the coast of Maine[2] the berries of this species are highly prized for food and are esteemed above the common cranberry for jellies and sauces.

The berries of *V. ovalifolium* are used largely by the natives of the Northwest in making a dainty which they call *le brou*. The berries are gathered before they are quite ripe, pressed into a cake, dried and laid by for winter use. "For use a quantity is put into a vessel of cold water and stirred rapidly until it appears somewhat like soap suds. It is pleasant to the taste, with a slightly bitter flavor."[3] Funston, in a recent report on the flora of Alaska, says concerning this species:[4] "A shrub four feet in height, forms a large part of the undergrowth near the coast (Yakutat Bay, Alaska). The dark purple berries, rather larger than peas, are collected in great quantities by the Indians who use them fresh and preserve them for winter, drying the fresh berries by artificial heat. In September, immediately after the close of the fishing season, nearly all the women

[1] Arb. et Fruit, 2:1165.
[2] Harvey, Trans. Maine Pom. Soc., 1895, 52.
[3] R. Brown, Jr., Bot. Soc., Edinburgh 9:384.
[4] Contrib. U. S. Nat'l Herb. 3:No. 6, cited by Gard. and For. 9:70, (1896).

and children devote themselves to collecting and drying blueberries for winter."

Of all the American species used for food, the most important are, perhaps, *corymbosum, Pennsylvanicum, Canadense,* and *vacillans.* The first of these, the High-bush Blueberry, or Swamp Blueberry, or "Huckleberry" of the middle west, is of firm texture, good size and excellent flavor. The shrub is easily transplanted, grows rapidly on any good soil and, more than any other species, shows a marked tendency to vary in the size, shape and quality of its fruit. It is the natural starting point in attempts to add the blueberry to the list of cultivated fruits. During the past few years it has received considerable attention as a garden fruit, especially in New England.[1]

The other species named grow mostly on uplands—*Pennsylvanicum* especially, on dry sandy "barrens"—and form the bulk of the blueberry crop as seen in the cities or at the canning factories.

USE FOR ORNAMENTAL PLANTING.

Among the plants which lend tone to the landscape in October and November by reason of their bright foliage, many of the species of Vaccinium may be included, the brilliant red, crimson and orange colors often persisting much longer than the bright hued leaves of a majority of other plants.

Of the ornamental species none are more strikingly beautiful late in the autumn than the common high bush blueberry—*V. corymbosum.* When well grown it is a stout, thick, spreading bush eight to ten feet high. The plant is beautiful when in flower; the fruit is attractive and of the best quality; and the bright scarlet and crimson effects in late autumn, rivalling the sumach in brilliancy, are unsurpassed. As an ornamental plant the species deserves a place in every garden.

Pennsylvanicum also brightens waste places for a short time, but drops its foliage too early to be worthy of planting as an under shrub. The same is true of *Canadense,* which is in many respects similar. *Stamineum* (the Deerberry), though early deciduous, is attractive when in bloom, and throughout the summer, by reason of its graceful habit. The deerberry is found

[1] The Blueberry in Maine, Rep. Me. Ag. Exp. Sta., 1898, 170.

over a wide range in the northern states and in the mountains south. Though usually found on gravelly soil, it will thrive in any good garden soil, and it is one of the very few ornamental shrubs specially suited for densely shaded situations. Although not abundant in our woods, it is not rare and its chaste beauty entitles it to a place among valuable native ornamental plants.

Arboreum, introduced into the Kew Gardens by John Cree in 1765, forms an irregular shrub too diffuse and straggling to be of value except in masses at the south. *Hirsutum*, from the mountainous regions of North Carolina and Alabama, is as beautiful in its autumn coloring as is *corymbosum* and like that species retains its foliage late in the season. *Vitis-Idæa* and *uliginosum*, with their shining box-like foliage, are effective as edging for the shrubbery border. *Ovatum* is characterized by Douglas[1] as "one of California's most beautiful hedge plants," but it has as yet received little attention in cultivation.

PROPAGATION.

The spread of any plant in cultivation is, to a large extent, dependent upon the activity of progressive nurserymen. If these men find a given class of plants difficult of propagation, such plants are seldom widely cultivated. In the past one chief drawback to the dissemination of the blueberries has been the difficulty, or supposed difficulty, of propagation. The few nurserymen who have offered them for sale have usually depended upon the native heaths and pastures for their supply of plants, rather than upon the nursery rows. The results have been most discouraging, and the blueberries, though among the finest of fruits, are almost unknown in cultivation.

In the case of the cranberries, propagation is performed almost exclusively by cuttings. With the blueberries grafting is easily performed and in this way specially choice individuals may be perpetuated. For general purposes, however, seedlings or division will be used. Propagation by seed naturally requires care and skill, but is entirely feasible, and the method may be detailed in this connection. At the Arnold Arboretum Jackson Dawson has for many years grown seedling blueberries, and his method is essentially as follows:[2]

[1] Gard. and For. 6:116, (1893).
[2] Cf. Country Gent. 1885, 660.

Seed pans or boxes, about four inches deep are half filled with potsherds and covered with a layer of sphagnum, after which a compost of the following composition is used: one part good fibrous peat (upland preferred), one part well rotted pasture sod, and one part clean fine sand, free from iron rust. The soil is firmed with the hand, or, better, with a mallet.

The seed, washed free from pulp of freshly gathered fruit, is then sowed thickly over the surface, pressed down slightly with a board and covered with the slightest possible sprinkling of soil. Over this is put a light covering of sphagnum and water is applied with a fine rose. The boxes are then placed in a cold frame and allowed to get a few hard frosts. About the first of January they are brought to a house with a night temperature of 55 to 60° and a range of 10° higher by day, watched carefully and kept moist but not saturated. As soon as the young seedlings appear, the sphagnum is gradually removed and a small quantity of compost sifted in among the plants.

When the first or second true leaf has expanded, the seedlings are pricked out into fresh pans or boxes prepared like the first; slight shade is given on bright days and the atmosphere of the house kept moist by wetting down the walks. The plants themselves are syringed but slightly; and the temperature is kept as even as possible.

About midsummer the plants are again handled and the same treatment as before is continued until about Sept. 1, when more air and less moisture are given, that the plants may be gradually hardened off and later removed to a cold frame for the winter. As frost approaches, the frames are protected with mats that the foliage may be retained as long as possible.

After the leaves drop, the frames are covered with a few inches of meadow hay, or litter and left for the winter; except that the frames are opened once or twice each month to admit the air. Early in April a bed, about 18 inches deep, of rich, peaty loam is prepared. In this the young plants are set four to six inches apart, syringed morning and evening and shaded by lath screens during the brightest sunshine until thoroughly established.

By the end of August all water is withheld, that the wood may ripen off for winter. At the approach of winter a few

inches of loam between the plants, to prevent heaving, is the only protection required. The following spring, or two years from seed, they may be planted out permanently.

Mr. Dawson has sown seed from September to January and, while most of it grew the first season, some delayed until the second year and then came up well. Seed that is kept until dry and then sown, even in autumn and kept in heat all winter, will seldom germinate until the second year.

Notes from Maine: At the Maine Experiment Station the writer has grown several hundreds of seedlings and, while in general following the method suggested by Mr. Dawson, has not found the extreme attention to details absolutely essential. Our practice has been to wash the seed from the pulp soon after harvesting, put it in cloth sacks and stratify in moist sand until early the following spring, allowing it to freeze in the meantime. Seed pans with liberal provision for drainage, are then filled with potting soil, to which is added a considerable portion of leaf mold, and the seed is sown as before described. Partly from force of circumstances, and partly from design, the seedlings were not given the best of care; but after being handled once were, late in the summer, transferred to the cold frame where they were simply covered with litter during the winter. The following spring they were transplanted into beds, shaded until established, and made a good growth during the summer. Naturally, however, the better care will produce larger plants and, where practicable, should be followed.

The low blueberry *(V. Pennsylvanicum)* will usually fruit in from three to four years from seed, but *V. corymbosum* requires four to six years.

CULTIVATION.

Within the past quarter of a century various spasmodic attempts have been made at the cultivation of the blueberry; though probably, as long as the fields and mountain slopes yield such an abundant natural supply as at present, this section of the genus Vaccinium will not receive the attention, in the way of cultivation and improvement, that its importance deserves. In the wild state the fruit is certainly more worthy of notice than was the blackberry, the raspberry or the currant.

Some writers have the mistaken notion that blueberries require a poor soil. One writer goes so far as to say: "Blueberries will not grow in cultivated ground, neither can they be grown from cuttings nor can their tips be layered. The only possible way to transplant them is to cut a sod from a matted berry patch and transplant it into *sod* ground. An old worn out pasture makes the best berry land."[1]

Such a statement hardly needs refuting. There is no doubt that the plants will do better if the roots are not too much disturbed in removal, but the poor sod land is not a requisite to successful culture.

In 1868 a successful amateur attempt at cultivation was made by J. W. Scott, Bridgewater, N. Y., but pressure of other work finally crowded it out.[2]

About 1875, Jackson Dawson, at the Arnold Arboretum, Jamaica Plains, Mass., began the culture of blueberries from seed, and has demonstrated the possibility of successfully cultivating most of the more common species.[3]

In 1883, and for a few succeeding years, Professor E. S. Goff of the New York Agricultural Experiment Station, made some attempts at culture, but the work finally yielded to the pressure of other duties. A similar fate befell like work at the Michigan Agricultural College in 1887.

In 1886, Frank Ford & Sons, Ravenna, Ohio, offered at least three different species of Vaccinium and one Gaylussacia in their nursery catalog and said: "This much neglected fruit, which is of great value and easy of cultivation, ought to be found in every fruit garden. Its perfect hardiness and adaptation to all kinds of soil, render it as easy of cultivation as any of the small fruits, and it can be grown anywhere that corn will grow."

In 1891 at least three American nurserymen offered blueberries for sale, and in 1893 as many as nine species were on the market—though not largely grown.

In 1898, at the Maine Agricultural Experiment Station the work was taken up systematically, and is still in progress.

[1] "S. A. H." Rural New Yorker, 1886, 252.
[2] An. Rep. N. Y. Agr. Exp. Sta., 1883, 287.
[3] Country Gentleman, 1885, 660.

Several instances of the successful and profitable garden culture of blueberries are cited in the Annual Report of the Maine Agricultural Experiment Station, 1898.[1]

While for the production of improved types it will doubtless be necessary to resort to the culture of seedling plants, the length of time required for results and the careful attention to details in the management of seedlings, as well as the uncertainty of results, will restrict such culture to the experiment stations, or to a few enterprising nurserymen. The ordinary fruit grower may, however, secure a stock of plants from a neighboring pasture or swamp, and by giving the same attention to culture which he would give to currants may secure very satisfactory results. For this purpose, the high-bush blueberry, *V. corymbosum* and its varieties are perhaps the best sorts. They are relatively easy to transplant, either from swamp or upland, and are of good size and very prolific. The variety *amœnum* is a rather dwarf form with very large berries and grows freely on the upland. *V. vacillans* is the next best species for cultivation as a "small fruit."

THE BLUEBERRY INDUSTRY.

Although from the earliest colonial times the blueberry has been highly prized as an article of food, very little attention has been given to the systematic exploitation of our resources in this direction.

In many of the northern and eastern states—particularly in New England, New York, Michigan and the mountains of Pennsylvania and West Virginia—there are thousands of acres of land worthless for agricultural purposes which, after the pine is removed, send up an abundant growth of blueberry bushes, alders, poplars, grey birches and spiræas. It is believed that by proper management these lands may be made to yield a handsome profit to their owners, and furnish employment to a large number of people.

At the present time these lands are, for the most part, considered as public property, and irresponsible parties, recognizing the fact that the blueberry crop is more abundant on young bushes which spring up after a fire, recklessly burn over vast areas and destroy valuable forests for their own selfish gain.

[1] Rep. Maine Agr. Exp. Sta. 1898, 170

Although very large quantities of fruit are gathered throughout the northern and Atlantic states, the industry has been more nearly systematized in New England than elsewhere. One writer in 1887 states[1] that he ships an average of 1,000 bushels a year from his farm in New Hampshire and as many more for his neighbors. He estimates that on one branch of the Boston & Maine Railroad as many as 20,000 bushels are shipped annually.

THE BLUEBERRY BARRENS.

In the southeastern part of Maine, there are about 150,000 acres known as the "blueberry barrens." Much of this land was burned over by the Indians before the colonial period and since the removal of the timber from the remainder, it too has been repeatedly burned to keep down the growth of birches and alders, and to facilitate the harvesting of the fruit.

About 40,000 acres of the barrens belong to Mr. William Freeman of Cherryfield, Maine, who may properly be regarded as the pioneer in the blueberry industry of America. After long and bitter litigation he proved beyond question his right to charge royalty for all fruit gathered on his lands and established a systematic method of treatment which is applicable, under most conditions, everywhere. The method is somewhat as follows:

[1] Country Gentleman, 1887, 565.

The land is divided into several tracts, each of which is leased to some responsible party who assumes the whole care of burning, keeping off trespassers, harvesting and marketing the fruit. The owner receives, as rental, one-half cent per quart for all the fruit gathered.

The pickers receive from one and a half to three cents per quart; those who lease the land and haul the fruit to the canning factory, or to the station for shipment, one-half to one cent per quart,—the rate being determined, in accordance with the market values, by the firm which handles the product. The fruit is all canned or shipped by one firm which keeps a record of the amount as it is brought in, and pays the royalty to the owner.

Every year a certain section of each "lease" is burned over. This burning must be done very early in the spring, before the soil becomes dry; otherwise the fire goes too deep, the humus is burned from the ground and most of the bushes are killed. Many hundred acres on what should be the best part of the "barrens" have thus been ruined. The method most commonly used in burning a given area, is for the operator to pass around the section to be burned, dragging after him an ordinary torch or mill-lamp. He then retraces his steps and follows over the burned area, setting new fires in the portions which have escaped and back-firing if there is danger of spreading unduly over areas which it is desired to leave unburned. A device occasionally used consists of a piece of one-half inch gas-pipe, bent at the end at an angle of about 60 degrees. The end opposite the bent portion is closed with a cap or plug, and in the other end, after filling the pipe with kerosene, is placed a plug of cotton waste or tow. This device is by many regarded as superior to the lamp or torch, as it is more easily handled. Each section of the lease is usually burned over every third year.

By far the largest proportion of the fruit is taken to the factories for canning. Early in the season, however, before the factories are opened, a considerable amount is shipped to the larger cities for use while fresh. This fruit is usually shipped in quart boxes, shown in the figure. The blueberries have an advantage over other small fruits in that, with the exception of currants and gooseberries, they will stand rough handling better, and will keep longer than the others.

A BOX OF BLUEBERRIES.

All of the early fruit is picked by hand, and only the ripe berries are gathered. Later in the season, particularly on "old burns," i. e. on areas which will have to be burned over the next year, the fruit is gathered with a "blueberry rake." This is an implement somewhat similar to the cranberry rake in use on Cape Cod, and may be likened to a dust pan, the bottom of which is composed of stiff parallel wire rods. The fruit may be gathered much more quickly and more cheaply by means of the rake. The bushes are, however, seriously injured by the treatment. In no case should the rake be used in gathering the high-bush blueberries. As the berries are gathered they are passed through a fanning mill before being sent to the canning factory; and again, at the factory, they are submitted to a much stronger winnowing. This is usually the only preparation necessary.

Wm. Freeman, Esq., Cherryfield, Maine, may properly be regarded as the father of the blueberry industry in America. His account of the beginnings of the industry is given herewith.

The canning of blueberries on a commercial scale was begun in Maine as early as 1866 when A. L. Stewart of Cherryfield packed some of the fruit procured from the neighboring wild lands for the Portland Packing Company. J. W. Jones, a pioneer in the corn packing industry, was engaged in the canning of blueberries in 1870, as were also William Underwood and Company, Jonesport, Maine.

BLUEBERRY RAKE.

Before canning the fruit was deemed practicable, "the plains" were considered common property and people came for fifty and even one hundred miles for a week's outing and to gather blueberries for their own use, and to sell to the merchants of neighboring cities and villages. The timber on the plains was fast being destroyed by fires which were set by the blueberry pickers and, in 1870, Mr. Freeman, who owned some forty thousand acres of the wild land, decided to charge a small royalty for the fruit picked on his lands. Most of the packers paid the small amount demanded without question, but the Underwood Company refused and after repeated attempts to get them to recognize his right of property, a suit for trespass was instituted by the owner. The trespass continuing, other suits were brought and the case was finally carried to the supreme court before it was decided. The final decision was a complete victory for Mr. Freeman—a judgment of $1,700 being granted and the

right of owners of public lands to sell "stumpage" for blueberry or other fruits being established once for all. Mr. Freeman's action not only benefited other owners of wild lands, as well as himself, but it resulted in the perfect system of management already detailed.

A BLUEBERRY CANNING FACTORY.

The financial importance of the blueberry industry is very difficult even to estimate at the present time. In Maine the canning of blueberries is largely in the hands of a few leading packers. The largest of these factories has a daily capacity of 700 bushels and the average annual output is 8,300 cases of two dozen cans each; representing 6,250 bushels of fresh fruit. The average price per case for the canned fruit is $1.90. In other words, the value of the annual product of this one factory is not far from $15,000.[1]

There were in 1900 seven factories in Maine which engaged in canning blueberries. These were as follows:

J. and E. A. Wyman, Cherryfield,
Burnham and Morrill, Harrington,

[1] This is the Wyman factory which handles Mr. Freeman's fruit. As will be seen, Mr. Freeman's royalty will amount to $1,000,—and this from land which is otherwise worthless.

L. A. and A. R. Logie, Columbia Falls,
J. A. Coffin, Columbia Falls,
A. L. Stewart and Son, Cherryfield,
Lawrence Bros., Jonesboro,
L. A. and A. R. Logie, Vanceboro.

The value of these factories is about $50,000. Those at Jonesboro and Vanceboro were erected in 1900.

The number of hands employed in the various factories would aggregate about a hundred, but including the pickers, there are from one thousand to two thousand men, women and children employed in the blueberry packing industry during the canning season. About $30,000 are distributed among the pickers each year.

The total canned product of the "blueberry barrens" in 1899 was about 50,000 cases and the price per case was $2.20, making the value of the blueberry crop in this one small section considerably more than $100,000.

In northern Michigan large quantities of fruit are shipped each year but there is no systematic management of the blueberry lands. The Western Express Company, through the courtesy of the Superintendent, Mr. S. A. Davis, records the following shipment of blueberries in northern Michigan for 1900: Saulte Ste. Marie, 650 cases (16 quarts each); Sturgeon River, 38 cases; Ispheming, 544 cases; Wetmore, 220 cases; Marquette, 200 cases; Seney, 1,719 cases.

The last season was a very poor one for blueberries in upper Michigan, the crop having been largely destroyed by late frost. Large quantities are usually shipped from Baraga, whereas none were shipped last year. From Wetmore, which reports 220 cases, the normal shipment is about 3,000 cases, and Sturgeon River which reports but 38 cases is usually one of the best shipping points.

WHITE BLUEBERRIES.

White or pinkish fruits, instead of the usual deep blue colored berries, are not uncommon in certain localities. In some cases these are simply albino forms; in others the color is due to a fungous growth. In the gardens of the Maine Experiment Station some of the albino forms are now fruiting, and, aside from the color, they are perfectly normal.

Albino forms of certain species—as *V. Myrtillus*—were early observed. Dodoens, in 1578, mentions "some that beare white Berries when they be rype, howbeit they are but seldome seen."[1] White fruits are catalogued by Ruppius in Flora Jenensis in 1726, and were found by Gmelin in Siberia in 1768.[2] In 1854, John Booth of Floetbeck nursery, near Hamburg, Germany, offered for sale plants of a white fruited form of *V. Myrtillus* which had been obtained from the Black Forest.[3] A white fruited form of *Vitis-Idæa* is also noted as occurring at Lyngdalen in the province of Christiansand in 1761.[4]

V. PENNSYLVANICUM, ALBINO.

White fruited forms of *Pennsylvanicum* and *corymbosum* have been observed by the writer; white *vacillans* is reported in

[1] Lyte's Dodoens 670.
[2] Cited by Sturtevant, Trans. Mass. Hort. Soc. 1890, 25.
[3] Loudon, Arb. et Fruit. 2:1157.
[4] Fl. Dan. 1:9.

Garden and Forest, 1893, and other species are recorded.[1] Ascherson and Magnus[2] have made a special study of the color and form variations of Vaccinium, and citations are given which show the very general distribution of albino forms throughout the world.

No special reason for this difference in color can be assigned. The white forms are found growing (usually in colonies) by the side of the normal type. If exposed to full sunlight, the fruit is very likely to have a blush cheek, or even to be of a scarlet color.

The albino forms must, however, be carefully distinguished from the "white berries" caused by the presence of a fungous growth. One of these white forms was described in 1859 by Döll as *V. Myrtillus* var. *leucocarpon.* But in 1879 Schroeter showed that the white color was due to a fungus which he called *Peziza baccarum* (now *Sclerotinia baccarum*).[3] Ten years later Woronin gave a full account of similar white berries found by him in Finland on *Vitis-Idæa, Oxycoccus* and *uliginosum,*—three species which are also common in the United States—and of the fungus producing the color.[4]

BOTANICAL NOTES.

Vaccinium (Origin of the name obscure); *Vacciniaceæ.*

Branching shrubs, creeping vines or small trees (sometimes epiphytes), with alternate, often coriaceous, evergreen or deciduous, sometimes membranaceous leaves; flowers small, white, pinkish or reddish in lateral racemes or terminal clusters, sometimes solitary in the axils, mostly nodding on slender bracted pedicels and bearing blue black or red berry-like fruits, mostly edible. *Calyx* 4-5 toothed, adherent to the ovary, persistent, forming a crown-like appendage to the fruit. *Corolla* various in shape, usually campanulate, cylindraceous or urn-shaped, rarely sub-globose, 4-5 toothed or cleft. *Stamens* distinct, included within the corolla tube or exserted; anthers often 2-awned at the back, the cells separate and prolonged upward

[1] Garden and Forest 8:503, (1895).
[2] Berichte d. deut. Bot. Gesell. 1890, 387-400.
[3] Gard. and For. 2:50, (1889).
[4] Mem. Acad. St. Petersburg, 1888.

into tubes at the apex, opening by terminal pores or chinks. *Pistil* single, with a 4-5 or 8-10 celled ovary which is glabrous or hirsute. Flowers in spring with or before the leaves, berries ripe in summer and autumn, sweetish or sometimes acid, mostly edible.

THE NATURAL GROUPS OF SPECIES.

In making the following natural divisions of the genus I have, in general, followed Bentham and Hooker, but have included the group Oxycoccus, after Gray in Synoptical Flora. When two closely related forms occur over a wide range in latitude, the assigned differences are very liable to fail at some point.

Key to the Groups.

A. Ovary 4-5 celled (rarely 8-10 celled in Vitis-Idæa).
  B. Stamens exserted
    C. Filaments villous.....OXYCOCCOIDES.
    CC. Filaments puberulent.....OXYCOCCUS.
  BB. Stamens included
    C. Filaments glabrous or pubescent EUVACCINIUM.
    CC. Filaments pilose.....VITIS-IDÆA.
AA. Ovary 10celled (sometimes imperfectly so in Cyanococcus).
  B. Anthers with two awns on the back...BATODENDRON.
  BB. Anthers awnless.....CYANOCOCCUS.

OXYCOCCOIDES, B. & H.

Erect branching shrubs with deciduous membranaceous leaves and berries of *Euvaccinium,* but with corolla of true *Oxycoccus:* flowers solitary, axillary, on long pedicels, pedicel bractless, but minutely 2-bracteolate at the base. *V. erythrocarpon*
V. Japonicum

OXYCOCCUS. (*Oxycoccus,* Pers.) Gray.

Corolla deeply 4-cleft or 4-parted; the lobes linear or lanceolate-oblong, reflexed; stamens 8, exserted, anthers awnless, with very long terminal tubes; ovary and berry 4-celled; flowers, pale rose-colored, axillary and terminal, nodding on long filiform pedicels; appearing in early summer; fruit maturing in autumn.

  C. Stems very slender, creeping.....*V. Oxycoccus*
  CC. Stems stouter, with ascending branches
V. macrocarpon

EUVACCINIUM, Gray.

Corolla ovate to globular, more or less urceolate, 4-5 toothed, rose or white; filaments glabrous; anthers 2-awned, included; ovary and berry 4-5 celled with no false partitions; leaves deciduous; flowers drooping, solitary or 2 or 4 together, developing with or soon after the leaves.

C. Corolla commonly 4-lobed; stamens 8..... *V. uliginosum*
CC. Corolla commonly 5-lobed; stamens 10.
  D. Plants dwarf, a foot or less high.
    E. Branches not angled ..... *V. cæspitosum*
    EE. Branches sharply angled ..... *V. Myrtillus*
  DD. Plants taller, 1—12 feet high.
    E. Margins of leaves sharply serrulate. *V. myrtilloides*
    EE. Margins of leaves entire (except in *ovalifolium*).
      F. Size of leaves ½ in. long. *V. ovalifolium*
      FF. Size of leaves ¼–¾ in. long. *V. parvifolium*
V. Mortinia

VITIS-IDAEA (Koch.) Gray.

Corolla cylindraceous, ovate, or globose-campanulate, more or less urceolate, rose or nearly white, 4-5 lobed, stamens included, filaments hairy; anthers awnless (or with short awns); leaves coriaceous and persistent; flowers in short racemes or clusters from separate buds; bracteate and 2-bracteolate.

C. Ovary 5-celled; stamens 10.
  D. Branchlets pubescent.....*V. ovatum*
  DD. Branchlets glabrous.....*V. crassifolium*
CC. Ovary 4-celled; stamens 8.
  D. Branches short (3-4 in.) from creeping stems *V. Vitis-Idaea*

BATODENDRON, Gray.

Corolla open-campanulate, 5 lobed; anthers tipped with long slender tubes, and 2-awned on the back; ovary and (hardly edible) berry falsely 10-celled; leaves rather firm in texture but deciduous; flowers axillary and solitary or in leafy-bracted racemes, slender pedicelled, bractlets minute or none.

C. Anthers included.....*V. arboreum*
CC. Anthers exserted.....*V. stamineum*

CYANOCOCCUS, Gray.

Corolla cylindraceous to campanulate-oblong or ovoid, 5-toothed; filaments hairy; anthers awnless, included; ovary and berry more or less 10-celled by false partitions; berry blue or black, usually with bloom, edible, many seeded; flowers, short pedicelled, (white or rose) in fascicles or very short racemes, developed with or a little before the leaves; buds separate, large, scaly; bracts and bractlets caducous or deciduous.

C. Foliage evergreen, coriaceous.
  D. Calyx-teeth roundish and very dense. *V. nitidum*
  DD. Calyx-teeth acute. ..... *V. Myrsinites*
CC. Foliage deciduous (sometimes tardily so in southern forms).
  D. Corolla cylindraceous ..... *V. Virgatum*
  DD. Corolla short and usually broad.
    E. Branchlets hirsute ..... *V. hirsutum*
    EE. Branchlets glabrous or glaucous (except in *V. Canadense*).
      F. Leaves glaucous and pale beneath. *V. vacillans*
      FF. Leaves strongly pubescent both sides. *V. Canadense* and var. *atrococcum* of *corymbosum*
      FFF. Leaves glabrous, often hairy on midrib beneath.
        G. Margin of leaves bristly-serrulate.
          H. Fruit mostly blue, glaucous. *V. Pennsylvanicum*
          HH. Fruit black... *V. nigrum*
        GG. Margin of leaves entire or at most ciliate. *V. corymbosum*

A HORTICULTURAL CLASSIFICATION.

As already indicated, the genus under consideration includes many species of particular importance as food plants, others which are useful only for ornament, and some which are valuable for both purposes. The following key to the more commonly known species is based upon leading horticultural characters.

A. Cultivated chiefly for fruit.
  B. Color of fruit red.
    C. Stems slender, trailing; leaves evergreen.
      D. Apex of leaves acute..... *Oxycoccus*
      DD. Apex of leaves obtuse or retuse. *macrocarpon*
    CC. Stems stouter though creeping; branches erect, tufted ..... *Vitis-Idaea*
    CCC. Stems erect, much taller (2-10 feet).
      D. Leaves small (¼–¾ inch long). *parvifolium*
  BB. Color of fruit blue or black.
    C. Plant low, ½–3 feet high.
      D. Foliage evergreen.
        E. Leaves small (¼–½ inch long). *nitidum*
        EE. Leaves larger (½–1 inch long). *Myrsinites*
      DD. Foliage deciduous.
        E. Surface of leaves glabrous.
          F. Leaves pale beneath, not shining above.... *vacillans* var. *pallidum* of *corymbosum*
          FF. Leaves not paler beneath (except sometimes in *Pennsylvanicum*); shining, at least above.
            G. Flowers solitary in the axils.
              H. Branches sharply angled. *Myrtillus*
              HH. Branches not angled. *cæspitosum*
            GG. Flowers in fascicles or short racemes.
              H. Fruit blue, glaucous *Pennsylvanicum*
              HH. Fruit black. *nigrum*

EE. Surface of the leaves hairy.
F. Ovary and fruit glaucous. *Canadense*
FF. Ovary and fruit hirsute. *hirsutum*

CC. Plant taller (3—12 feet), spreading.
D. Flowers solitary in axils.
E. Leaves sharply serrate.. *myrtilloides*
EE. Leaves entire or slightly serrulate *ovalifolium*
DD. Flowers in racemes or corymbs.
E. Racemes elongated on naked branches..... *virgatum*
EE. Racemes shorter..... *corymbosum*

AA. Cultivated chiefly for ornament.
B. Plants low, 1—2 feet high.
C. Stems creeping, with branches erect or ascending.
D. Leaves small, shining..... *crassifolium*
DD. Leaves larger, pale or glaucescent. *uliginosum*
CC. Stems erect; twigs red ..... *erythrinum*
BB. Plants taller, 2-20 feet high.
C. Foliage evergreen, rigid..... *ovatum*
CC. Foliage deciduous.
D. Surface shining above, more or less pubescent beneath ..... *arboreum*
DD. Surface paler above, glaucous beneath. *stamineum*
DDD. Surface bright green both sides. *erythrocarpon*

THE MOST IMPORTANT SPECIES.

V. Oxycoccus, L. (Small Cranberry)

Linnæus, Sp. Pl. 351, 1753.

(*Synonyms: Oxycoccus palustris,* Pers., Syn. Pl. 1:419; *Oxycoccus vulgaris,* Pursh. Fl. 1:263.)

Slender creeping plants with short (4-10 inch) filiform stems, leaves ovate, acute or acuminate, ¼ inch long, with revolute

margins; pedicels 1-4, terminal; corolla deeply 4-parted, the lobes reflexed; anthers exserted, with very long terminal tubes; berry red, globose, ¼-⅓ inch in diameter, 4-celled. (*Figured:* Sowerby, Eng. Bot. ed. 1, 5: 319; Schlecht., Fl. von Deutch. 20: 2039; Reich., Icon. Fl. Germ. 17, t. 1169.)—Sphagnous swamps, Europe, north and middle Asia, North America, Greenland to Japan mostly in sub-arctic and alpine regions, Newfoundland to Alaska and southward to mountains of Pennsylvania, common on rocky islands along the coast of Maine. The cranberry of the old world. It is distinguished from the next species, the American Cranberry, by its very small pointed leaves, rarely ¼ inch long, and by the short ovate segments of the corolla as well as by the terminal inflorescence. Though smaller, its fruit is by many considered superior to that of the next.

V. macrocarpon, Ait. (Larger American Cranberry)

Aiton, Hort. Kew, 2: 13, 1789.

(*Synonyms: V. oxycoccus* var. *oblongifolius,* Michx. Fl. Bor. Am. 1: 228; *Oxycoccus macrocarpus,* Pursh. Fl. 1: 263.)

Stems slender, creeping, elongated (1-4 feet), the flowering branches ascending; leaves oblong or oval, obtuse or retuse, ⅓-½ inch long; whitened beneath; pedicels several, axillary and lateral; berry red or reddish, globose or pyriform, ⅓-1 inch long. (*Figured:* Ait. Hort. Kew, ed. 1, 2: 13, t.7; Bot. Mag. t.2586; Emerson, Trees and Shrubs of Mass., ed. 5, 2: 456; Meehan, Flowers and Ferns 2: 28; Wein, III. Gart. Zeit. 1: 81; as *Oxycoccus macrocarpus* Bart. Fl. 1, t.17.)—Peat bogs, Newfoundland to North Carolina and westward.

This is the common large fruited cranberry, under cultivation in Massachusetts, New Jersey and elsewhere.

V. Vitis-Idaea, L. (Cowberry, Mountain Cranberry, Foxberry)

Linnæus, Sp. Pl. 351, 1753.

(*Synonyms: V. Punctatum,* Lam. Fl. Fr. 3: 396; *V. punctifolium,* Stokes, Bot. Mat. Med. 2: 363; *V. buxifolium,* Gillb. Fl. Lituan. 1: 4; *V. nemorosum,* Salisb. Prod. 291.)

Plants low (6-10 inches); branches erect from tufted creeping stems; leaves coriaceous, persistent, obovate or oval, ¼-¾ inch

long, dark green and shining above, with blackish bristly points beneath; flowers in short terminal racemes; corolla white or rose-colored, 4-cleft; berries dark red, acid, rather bitter. (*Figured:* Fl. Dan. t.40; Lodd., Bot. Cab. t.616 (as var. "major"); Bot. Cab. 1023 (var. "minor").) Arctic regions of Europe, Asia and Greenland to Japan; south to the coast of New England, Minnesota and British Columbia.

A low, evergreen, shrubby plant which grows in cold and elevated situations in the northern parts of both hemispheres. The blossoms are very delicate and the fruits, which are rather larger than currants, acid and somewhat bitter when uncooked, are largely used in the more northern regions for tarts, jellies and preserves, or as a substitute for the common cranberry. According to Macoun (Gard. and For. 2: 508), the fishermen's families along the Gaspé coast and the north shore of the Gulf of St. Lawrence, gather the fruit of this species in large quantities, for their own use and for sale, calling it "Low-Bush Cranberry." Throughout the whole of northern Canada, hunters and trappers, as well as the native Indians, have frequently to depend upon it for food.

The plant spreads rapidly, is hardy and requires no special care. It is valuable for the shrubbery border where the strong contrast of the dark green foliage and the bright colored persistent fruit is very striking.

V. parvifolium, Smith.

Smith in Rees Cycl. no. 13, 1817; Gray Syn. Fl. 2: 24.

Shrub 6-12 feet high, straggling; with slender, green, sharply angled branches; leaves oblong or oval, obtuse, entire, dull or pale, ¼-¾ inch long; flowers solitary in the axils, corolla globular, nearly white, calyx 5-lobed; berries light red, rather dry. (*Figured:* Hook. Fl. Bor. Am. t.128.)—Shady and low woods, northern California, near the coast to Alaska.

A somewhat straggling shrub, offered for sale by one nurseryman. Of interest rather than of special merit. T. J. Howell of Oregon characterizes the fruit as "of good flavor, excellent for tarts," while Gray says "rather dry, hardly edible."

V. erythrocarpon, Michx.

Michaux, Fl. Bor. Am. 1: 227, 1803.

(*Synonyms: Oxycoccus erectus,* Pursh, Fl. 1: 264; *O. erythrocarpus,* Elliott, Sketches 1, 447.)

Shrub, erect, divergently branching 1-4 feet high; leaves oblong-lanceolate, acuminate, serrate, thin, 1½-3 inches long; pedicels solitary, axillary, bractless; corolla flesh-colored, ½ inch long, 4-cleft, revolute, berries globose, ½ inch in diameter, light red, turning to deep blue-black at full maturity, watery, slightly acid, "of exquisite flavor," Don. (Not usually regarded as valuable.) (*Figured:* Bot. Mag. t.7413; (as *Oxycoccus erectus*) Wats. Dendrol. Brit. 1, t.31)—Damp woods, higher Alleghanies Virginia to Georgia, July.

A remarkable species in that it combines the flower structure of the Oxycoccus group wth the erect habit and foliage character of the other vacciniums. The specific name is somewhat misleading since, when mature, the fruit is similar to the blueberries, though without the distinct crown of the persistent calyx, found in other vacciniums.

The species was introduced into England in 1806 by Loddiges, but has been cultivated only in botanic gardens.

A closely allied species, *V. Japonicum,* Miquel., (Miq. Ann. Mus. Bot. Lugd. Bot. 1: 28, 1863; Maximowicz, Diagnoses Pl. nov. Jap. et Mand., in Bul. Acad. Sci. St. Petersburg 8: 603, 1871) is found in central and northern Japan, but has not been introduced into cultivation.

V. nitidum, Andr.

Andrews, Bot. Rep. t.480, 1805.

A diffusely much branched shrub, with smooth branchlets, leaves thick coriaceous, shining above, obovate or oblong; flowers in fascicles on short racemes; the almost persistent bracts as well as the roundish or obtuse calyx-teeth reddish; corolla short campanulate, 5-toothed; berry "somewhat pear-shaped, black." (*Figured:* Bot. Rep. t.480.) —Low pine barrens, Florida and Georgia. (Near to or passing into *Myrsinites*).

V. Myrsinites, Lam.

Lamarck, Encyc. 1:73, 1783.

(*Synonym: V. nitidum* var. *decumbens,* Sims, Bot. Mag. 1550.)

Low evergreen shrub, erect or decumbent; branches, when young, puberulent; leaves exceedingly variable, oblong-lanceolate and acute to obovate and obtuse, ¼-1 inch long, entire or serrulate, sometimes denticulate, mostly shining above; bracts and calyx-teeth acute or acutish; berries "globose, blue." (*Figured:* (as *V. nitidum* var. *decumbens*) Bot. Mag. t.1550) —Sandy pine barrens, North Carolina to Florida and Louisiana.

The difference between this species and the preceding is obscure. The chief points of distinction seem to be that *Myrsinites* has puberulent branchlets, prominently veined leaves and acute calyx-teeth and bracts; while *nitidum* has smooth branchlets, smaller and faintly veined leaves, with obtuse or roundish calyx-teeth and bracts.

The species is grown as a pot plant in cool houses in England under the name of *V. Sprengelii.* (Gard. Chron. n. s. 19:473, 1883).

V. vacillans, Kalm, (Low Blueberry, Blue Huckleberry)

Kalm in Herb. Banks; Torr., Fl. N. Y., 1:444, 1843.

(*Synonyms: V. vacillans* Solander, Gray, Man. ed. 1, 261; *V. virgatum* Bigelow, Fl. Bost., ed. 2, 152; *V. Pennsylvanicum* Torr., Fl. N. U. S. 1:416, in part.)

Erect, glabrous, with pale yellowish-green branchlets; leaves obovate or oval, entire or sparingly serrulate; flowers in rather loose clusters, generally on leafless summits of twigs; corolla campanulate or cylindraceous, contracted at the mouth; berries large, blue, with much bloom, of excellent flavor, ripening with *V. Canadense.* (*Figured:* Emerson, Trees and Shrubs of Mass., ed. 5, 454.)—Dry, sandy or rocky places, Maine to North Carolina, westward to Michigan and Missouri.

One of the most common species of the northern and central states, particularly west of the Alleghanies. The flowers, on terminal and lateral naked branchlets, yellowish white, often tinged with red, are quite showy; while the fruit is particularly

valuable. The only form it is likely to be confused with is variety *pallidum* of *corymbosum* and from this it is distinguished by the veins and ribs of its leaves being perfectly smooth. Well worthy the attention of cultivators.

V. Myrtillus, (Whortleberry, Bilberry)

Linnæus, Sp. Pl. 350, 1753.

(*Synonym: V. myrtilloides,* Watson, Bot. King Exp. 209, not of others.)

Low shrubs, glabrous; leaves ovate or oval, serrate, conspicuously veined, ½-⅔ inch long; calyx almost entire; berries black, nodding. (*Figured:* Reichenb., Ic. Fl. Germ. 17: 118, t.1169; Eng. Bot., ed. 1, 7: 456; Schlecht., Fl. von Deutch. 20: 2036; Twin. Ill. Nat. ord. 2: 83.)—Mountainous regions Alaska to Colorado and Utah; Europe, Asia.

The most widely distributed species and very generally used as an article of diet and in the making of drinks, particularly in the old world. It is from this species that the common name whortleberry is derived, as stated elsewhere. Not of special importance in America.

V. caespitosum, Michx., (Dwarf Bilberry)

Michaux, Fl. Bor. Am. 1: 234, 1803.

A very dwarf tufted shrub, 2-12 inches high; nearly glabrous throughout; leaves obovate, obtuse or acutish, serrulate, shining on both sides; flowers solitary, corolla obovoid, pink or white, slightly 5-toothed (rarely 4-toothed); berries large, globose, blue with bloom, sweet. (*Figured:* Bot. Mag. t.3429.)—Hudson's Bay and Labrador to Maine and New Hampshire, also alpine summits of Adirondacks; in the Rocky Mountains, Colorado and Utah to Alaska, east to Lake Superior.

It is doubtful if varieties can be distinguished. Var. *arbuscula,* Gray, passes into the ordinary form; while *angustifolium,* Gray, and *cuneifolium,* Nutt., are found to be simply forms produced by shade. The latter form, particularly, is common in New England and early in the season the leaves are of the ordinary obovate type, while later they become elongated.

A boreal or Canadian species of rather limited distribution in the East, common in Maine north of latitude 44° 50′; not found in Labrador north of latitude 54°. York, Maine, is the most southern station known. It is generally regarded as a plant of the highest alpine summits in New England, but it is not uncommon in other localities throughout central and northern Maine. It is abundant at Orono, and Fernald has found that "in the valleys of the Penobscot and its tributaries, the Piscataquis, the Mattawamkeag, and the Wassataquoik, the plant is to be found on almost any ledgy or gravelly riverbank." Most abundant in the valley of the upper St. John.

V. Pennsylvanicum, Lam. (Low Blueberry)

Lamarck, Encyc. 1: 72, 1783.

(*Synonyms: V. myrtilloides,* Michx., Fl. Bor. Am. 1: 223; *V. tenellum,* Pursh, Fl. 1: 288 and Bigel. Fl. Bost. 150, *not* Ait.; *V. angustifolium,* Ait., Hort. Kew, ed. 2, 2: 356; *V. multiflorium,* Dunal in D. C. Prod. 7: 572; *V. salicinum,* Aschers. Flora, 1860, 369, *not* Cham.; *V. multiflorum,* Wats. Dendr. Brit. t.125 (?); *V. ramulosum and humile* Willd. Enum. Suppl. 20 (?).)

A dwarf shrub (6-15 inches) with slender greenish, warty, mostly glabrous branches; leaves membranaceous, oblong-lanceolate or oblong, distinctly serrulate with bristle-pointed teeth, mostly shining on both sides but often hairy on midrib beneath; flowers on short pedicels; corolla campanulate-cylindrical, short; berries large, globose, bluish-black with bloom, sweet; the earliest to ripen north. (*Figured:* Bot. Mag. t.3434; Emerson, Trees and Shrubs of Mass., ed. 5, 2: 456; (photo.) Rep. Maine Agr. Exp. Sta. 1898, 171.)—Dry hills and woods Newfoundland and the Saskatchewan southward to New Jersey and Illinois.

Var. *angustifolium, Gray,* (Man. ed. 1, 261) A dwarf form, with more decidedly lanceolate leaves. *V. angustifolium,* Ait. l. c., *V. salicinum,* Aschers, l. c., not Cham. Summits of mountains northern New York and New England, Quebec to north shore of Lake Superior and northward.

This species is extremely variable in size and shape of fruit and flowers, but with the exception of the variety noted, and the black fruited form often associated with it, which is set off as

V. nigrum, the variations do not appear sufficiently constant to warrant making separations. In general, the plant is of low, semi-prostrate habit, is extremely prolific and thrives on dry sandy hills. It furnishes the bulk of the blueberries found in the eastern markets. When mown down or burned, the new erect shoots produce, the following year, a long spike-like mass of bloom and fruit which may be stripped off by handfuls. Because of its character, and early ripening habit, it is known on the blueberry plains as "early sweet" or "low sweet."

V. PENNSYLVANICUM.

V. nigrum, Britton, (Low Black Blueberry)

Britton, Mem. Torr. Club 5: 252, 1894.

(*Synonym: V. Pennsylvanicum* var. *nigrum,* Wood, Bot. and Flor. 199, 1873.)

Low shrub, similar to *V. Pennsylvanicum* and often associated with it. Leaves oblong-lanceolate to obovate, finely serrulate, green above, pale and glaucous beneath; flowers few in the clusters, white or cream colored, appearing earlier than those of *Pennsylvanicum;* berries rather small, black without bloom. (*Figured*: (photo.) Rep. Maine Exp. Sta., 1898, 171.)—Dry rocky soil, Maine to New Jersey, westward to Michigan.

V. NIGRUM.

The species is distinguished from the preceding by the glaucous under surfaces of the leaves and by the characteristic shining, black fruit. It is usually found in colonies in the same situations as *Pennsylvanicum;* but occasionally the two species will be found intermingled.

V. Canadense, Richards. (Canada Blueberry)

(Named by Kalm in Herb Leche, now in Herb Banks; Richardson, in Frankl. 1st Jour. ed. 2, App. p. 12; Hooker, Fl. Bor. Am. 2:32. *Synonym: V. album,* Lam. Encyc. 1:73, not L.)

Erect shrubs, 1-2 feet high, the crowded branchlets downy-pubescent; leaves oblong-lanceolate or elliptical, entire, downy both sides; corolla short, open-campanulate, greenish-white, often tinged with red; berries globose or oblate, blue with much bloom, of excellent flavor. (*Figured:* Bot. Mag. t.3446.)—Low woods, Hudson's Bay to Bear Lake and the northern Rocky Mountains; south to New England, mountains of Pennsylvania and Illinois.

This species, commonly known as "sour top" or "velvet leaf" because of the character of its foliage and the somewhat acid fruit, usually grows in rather moist, rocky, not swampy localities. The fruit is larger and more acid than the other low forms and matures from one to three weeks later. It is not so popular in the general market as the sweeter kinds, but it is very prolific and its lateness in ripening is a point in its favor.

V. CANADENSE.

V. hirsutum, Buckley, (Hairy Blueberry, Bear Huckleberry)

Buckley, Am. Jour. Sci. 45: 175, 1843; Sargent, Gard. & For. 2: 365.

Low shrub, 1-2 feet high, the stems green, grooved, obscurely 4-angled, those of the current year covered with stout, spreading, white hairs; leaves ovate, entire and, together with the pure

white, campanulate, corolla, the calyx and the dark blue globose fruit, hirsute. (*Figured:* Gard. and For. 2: 365.)—Mountains of Cherokee County, North Carolina, (Buckley, Sargent); Tallulah Falls Cañon, Georgia, (J. K. Small); Cade's Cove Mountains, Tennessee, (A. Ruth).

This species, discovered about 1840 by B. S. Buckley "in the mountains of Cherokee County," North Carolina, was lost sight of for half a century until re-discovered by Sargent at Robbinsville, Graham County, North Carolina in 1887, when it was transferred to the Arnold Arboretum. Practically nothing is known of its geographical distribution or habitat. It is readily distinguished, however, by the hairy flower and fruit.

The fruit is described as fully as large as that of *Gaylussacia resinosa,* shining black, and of an agreeable flavor. Under cultivation not so densely hairy as in the wild state. Gives promise of being valuable under cultivation as one of the latest of its kind to ripen,—at the Arnold Arboretum the best period of fruitage being the middle of August, berries remaining into September. It is probable that good results might be obtained by hybridizing with *V. corymbosum* or *V. Canadense.*

V. myrtilloides, Hook. (Gray).

Gray, Man., ed. 5, 291; Syn. Fl. 2: 24, not Michx.

(*Synonym: V. membranaceum,* Douglas ined.)

An erect branching shrub mostly glabrous throughout, the twigs slightly angled; leaves oval, oblong or ovate, acute, serrate, membranous, green both sides but not shining, 1-2 in. long: calyx entire; corolla depressed-globular, yellowish or greenish white; berries large, oblate, black, rather acid. (*Figured:* Bot. Mag. t.3447.) Moist woods, Lake Superior to the coast of Oregon and British Columbia.

The berries are large ½-¾ inch, oblate, with broad calyx; of excellent flavor; much relished by the natives of the northwest. (Howell, in Case Bot. Index, 1881, 38.)

V. ovalifolium, Smith.

Smith, in Rees Cycl. no. 2, 1817; Hook, Fl. Bor. Am. 2: 33.

A slender, straggling, branched shrub 3-12 feet high, with slender, more or less angled branchlets; leaves oval, obtuse, glabrous, green above, glaucous beneath; flowers solitary, on short

recurved pedicels, corolla globose-ovoid; berry large (⅓-½ inch) bluish-purple, with bloom. (*Figured:* Hook. Fl. Bor. Am. 2: 33, t.127)—Woods, Quebec to Michigan, Oregon and Alaska.

This species is very abundant in the northwest, forming a large part of the undergrowth along the southern coast of Alaska, (Funston); but, like many other plants of a similar range it extends eastward through the region of the Great Lakes and the St. Lawrence River. The berries, rather larger than peas, are collected in great quantities by the Indians who use them fresh and dry them for winter. The exceptionally large berries and vigorous habit of this species suggest its value for cultivation and particularly for crossing with the low growing species such as *Pennsylvanicum* and *Canadense.*

V. virgatum, Ait.

Aiton, Hort. Kew, ed. 1, 2: 12, 1789.

(*Synonyms: V. ligustrinum,* Pursh, Fl. Am. Sept., 1: 288, not L.; *V. fuscatum* Ker., Bot. Reg. t.302 (?); *V. Elliottii,* Chapm., Fl. So. U. S. 260.)

A shrub 3-12 feet high, with slender, green branches, the young twigs puberulent; leaves narrowly oval-oblong, acute, often mucronate, entire or minutely serrulate, green and glabrous above, pale or glaucous beneath, ¾-2 inches long; flowers in short racemes on naked twigs; appearing before the leaves; bracts small, deciduous; corolla nearly cylindrical, white or pink; berry black with or without bloom. (*Figured:* Bot. Rep. t.181; Bot. Mag. t.3522; (as *V. fuscatum)* Bot. Reg. t.302.)—Swamps, southern Virginia to Florida and Louisiana.

Var. *tenellum* (Ait.) Gray, (Syn. Fl. 2: 22). A low form, mostly less than 2 feet, with smaller leaves and nearly white flowers in short close clusters. (*V. tenellum,* Ait. l. c., not Pursh; *V. galezans* Michx. Fl. Bor. Am. 1: 232; *V. galiformis,* Smith, Rees' Cycl. no. 16)—Southern Virginia to Arkansas, Florida and Alabama. Probably a distinct species.

The distinction between this species and the next is very slight. It is probable that, possibly excepting var. *tenellum,* this is only a southern form of *corymbosum* and should be reduced to varietal rank, following Don (Gard. Dict. 3: 854).

V. corymbosum, L. (High-bush Blueberry, Swamp Huckleberry)

Linnæus, Sp. Pl. 350, 1753.

(*Synonym: V. disomorphum,* Michx., Fl. Bor. Am. 1: 223.)

A tall, straggling shrub 4-12 feet high, with yellowish-green, warty, branchlets which later turn brownish; leaves ovate or oblong to elliptical-lanceolate, usually entire; flowers in short racemes on naked twigs; corolla ovate to urn-shaped, or oblong-cylindrical, white or pinkish; berries blue-black with much bloom, of excellent flavor. *(Figured:* Emerson, Trees and

V. CORYMBOSUM.

Shrubs, ed. 5, 2: 454; Am. Ag. 1886, 364.)—Moist woods or swamps, Newfoundland and Canada to Michigan and Minnesota; through eastern United States to Louisiana; rather rare in the Mississippi valley. Exceedingly variable, and numerous gradations unite the several varieties.

Var. *amœnum,* Gray, (Man., ed. 5, 292), a form with bristly-ciliate, serrulate leaves, bright green both sides, shining above, often pubescent on veins beneath. (*V. amœnum,* Ait., Hort. Kew., ed. 1, 2: 12; Bot. Rep. t.138; Twin. 111. Nat. Ord. 2: 83, 6; Bot. Reg. 400. *Figured,* as *V. corymbosum,* Bot. Mag. t.3433.) Mainly in the Middle Atlantic States.

Var. *pallidum,* Gray, l. c., a pale and glaucous or glaucescent form, with or without some pubescence; ovary more completely inferior, generally low; otherwise resembling *amœnum.* (*V. pallidum,* Ait. l. c.; Gray, Man. ed. 1, 262. *V. albiflorum,* Hook, Bot. Mag. t.3428. *V. Constablœi,* Gray, Am. Jour. Sci. 42: 42). Common in mountainous regions southward.

Var. *fuscatum,* Gray, (Syn. Fl. 2: 23), a tall form with the mature and entire leaves fuscous-pubescent beneath; flowers virgately somewhat spicate on the naked flowering twigs. (*V. fuscatum,* Ait., l. c.) Alabama and Florida to Louisiana and Arkansas.

V. corymbosum is one of the most valuable species both for fruit and as an ornamental shrub. It thrives in the garden and is readily susceptible of improvement by cultivation. Toward the south it approaches *V. virgatum,* Ait., and var. *pallidum* may be confused with *V. vacillans,* Kalm.

V. atrococcum, Heller, (Black Blueberry)

Heller, Torr. Bull. 21: 24, 1894.

(*Synonyms: V. disomorphum,* Bigel. Fl. Bost., ed. 2, 151, not Michx.; *V. corymbosum* var. *atrococcum,* Gray, Man., ed. 5, 292.)

A branching shrub with shreddy bark, similar to *V. corymbosum.* Leaves oval or oblong, dark green above, densely pubescent beneath, entire, acute, often mucronate; flowers in short racemes, appearing with the leaves; berry black without bloom, sweet. Moist woods and swamps, Canada to Pennsylvania and New Jersey.

V. crassifolium, Andr.

Andrews, Bot. Rep. t.105, 1798.

(Synonyms: V. carnosum, Pers. Syn. Pl. 1:479; *V. myrtifolium,* Michx. Fl. 1:228.)

Slender, trailing shrub; stems 2-3 feet long, glabrous; leaves small, ¼-½ inch long, oval or narrowly oblong, sparsely serrulate or entire, shining; flowers few, almost sessile, in small axillary clusters, nearly white, or tinged with red; berries black. *(Figured:* Bot. Rep. t.105; Bot. Mag. t.1152.)—Sandy bogs, near the coast, North Carolina to Georgia.

Useful for the shrubbery border, south.

V. uliginosum, L. (Bog Bilberry)

Linnæus, Sp. Pl. 350, 1753.

(Synonym: V. gaultherioides, Bigel. New Eng. Med. Jour. 5:335.)

A stiff, much branched shrub ½-2 feet high; leaves thick, obovate or oval, obtuse or retuse, ½-1 inch long, nearly sessile; flowers 2-4 together, or sometimes solitary; calyx 4-parted, sometimes 5-parted; corolla urn-shaped, 4 or 5-lobed, pink; stamens 8-10; berries bluish-black with bloom. *(Figured:* Fl. Dan. t.231; Reichenb. Ic. Germ. 17, t.1168; Sowerby, Eng. Bot. 6:878 (Ibid. ed. 1, 9:581); Deakin, Flor. Brit. 2, 19, 630; Schlecht., Flor. Deutch. 20:2037; Pratt, Fl. Pl. 3:351.)—Labrador to New England; mountainous regions of New York; Lake Superior to Alaska. Also in northern Europe and Asia.

Usually considered a high mountain species, but found by the writer on the blueberry barrens of eastern Maine and reported as abundant along the ledgy shores of the Carrabassett River (Fernald) and along the St. John at Fort Kent (Furbish) in the same state. The varieties *mucronatum* Herder, and *microphyllum,* Lange, the former from Alaska and the latter from the west coast of Greenland, lat. 70° (Schuchert and White, Torr. Bul. 27:66) are not of importance.

The plant is useful for the shrubbery border in cold wet locations, and its fruit though of poor quality, is used for food by the natives of the northwest.

V. erythrinum, Hook.

Hooker, Bot. Mag. t.4688, 1852.

An erect, glabrous, evergreen shrub with bright red twigs; leaves ovate, obtuse, coriaceous, entire; flowers in long, one-sided, terminal racemes; corolla cylindraceous, 5-toothed, ½ inch long, purple, reddish. *(Figured:* Bot. Mag. t.4688; Lemaire, Jard. Fl. 4: 364; Jour. of Hort. 34: 39.)—Mountainous regions, Java.

Sent to England in 1852 and since grown by various nurserymen as a greenhouse pot-plant. It is a strong plant, furnishing an abundance of bloom in December and January. Not remarkable, but worthy a place in collections. A very distinct type, the only other representative of which, so far as observed, is *V. Rollisoni,* Hook, (Bot. Mag. t.4612).

V. ovatum, Pursh.

Pursh, Fl. Am. Sept., 1: 290, 1814.

(Synonyms: V. lanceolatum Dunal in D. C. Prod. 7: 570; *Metagonia (Pyxothamnus) ovata,* Nutt., Trans. Am. Phil. Soc. ser. 2, 8: 262.)

An erect, rigid, evergreen shrub, 3-8 feet high, with pubescent branchlets; leaves very numerous, thick, shining, ovate or oblong, acute, serrate; flowers numerous, in short axillary clusters, followed by dark purple fruit of agreeable flavor. *(Figured:* Bot. Reg. t.1354; Lemaire, Jard. Fl. 4: 424.)—Vancouver's Island to Monterey, California.

A distinctly western species, and one of California's most beautiful hedge plants, but not well known. *V. ovatum* is very tenacious of life and bears pruning well; propagated from suckers, cuttings, and seeds which it bears freely. Most abundant on the northern mountain slopes of the coast range; but also found growing luxuriantly on southern slopes exposed to bright sunlight. (T. H. Douglas, Gard. & For. 6: 116, 1893).

V. arboreum, Marshall, (Farkleberry, Sparkleberry)

Marshall, Arbust. Am. 157, 1785.

(Synonyms: V. diffusum, Ait. Bot. Mag. t.1607, *Batodendron arboreum* Nutt., Trans. Am. Phil. Soc. ser. 2, 8: 261 and Sylva, 3: 43.)

Spreading shrub or small tree 6-25 feet high, with glabrous or somewhat pubescent branchlets; leaves thinnish-coriaceous, smooth and shining above, obovate to oblong, entire to obscurely denticulate; flowers profuse, axillary and leafy racemose; corolla white, 5-lobed; berry small, globose, rather astringent. (*Figured:* Lodd. Bot. Cab. t.1885; as *V. diffusum,* Bot. Mag. t.1607.)—Sandy soil along river banks, Florida and Texas to North Carolina and Illinois.

The flowers are solitary and axillary along the terminal branchlets, each pedicel being curved near the flower. The leaves on these flowering branchlets are only about half the size of other leaves on the same branches, though in other respects similar. Some regard these leaves as bracts, and regard the inflorescence as "leafy racemose."

The species was introduced into the Kew Gardens in 1765 by John Cree. It forms an irregular shrub too diffuse and straggling to be of value except in masses, for which purpose it is useful at the south.

V. stamineum, L. (Deerberry, Squaw Huckleberry)

Linnæus, Sp. Pl. 350, 1758.

(*Synonyms: V. elevatum* Solander; Dunal in DC. Prod., 7: 567. *V. album,* Pursh, Fl. Am. Sept. 1: 285, not L.)

A divergently branched shrub 2-5 feet high with pubescent or glabrous twigs; leaves oval to oblong-lanceolate, acute, entire, pale, glaucous or sometimes slightly pubescent beneath, 1-4 inches long, ½-1½ inches wide; flowers very numerous in large, leafy-bracted racemes; corolla green, 5-cleft; anthers and style exserted; fruit large, globose or pyriform, greenish or yellowish, few-seeded, almost inedible. (*Figured:* Bot. Rep. t.263. *V. stamineum* H. B. & K. t.353, the *V. Kunthianum,* Klotzsch, has shorter anther tubes and a hairy ovary.)—Dry woods and thickets Maine to Minnesota, south to Florida and Louisiana; rare west of the Alleghanies.

The Deerberry is found over a wide range in the northern states and in the mountains south. It is also recorded as one of the principal plants of the dry pine barrens of southern Georgia (Harper). It is usually found naturally on gravelly

soils in the shade of deciduous trees—particularly black oaks—but will thrive on any good, well drained soil and is a valuable shade-enduring ornamental shrub.

Var. *melanocarpum,* Mohr, (Southern Gooseberry, Mohr, Torr. Bul. 24:25, 1897). Shrub 2-3 feet high, branched from near the base; leaves as in the type, flowers in loosely 4-8 flowered elongated racemes; berries twice the size of the typical form, shining black, with a juicy purple pulp, sweetish, with slightly tart pleasant flavor. Rocky, shaded hills in the mountain region of central and northern Alabama. (Mohr).[1]

Supplementary List of American Species.

The following species from various parts of America have been described but as a rule are little known:

From Mexico: *angustifolium* Benth (not Ait.); *confertum,* H. B. & K.; *cordatum,* Hemsl.; *eriocladum* Dunal; *geminiflorum,* H. B. & K.; *Kunthianum,* Klotzsch; *leucanthemum,* Schlecht.; *micranthum,* Dunal; *Schlechtendallii,* G. Don; *villosum,* Smith.

From Central America: *consanguineum,* Klotzsch; *pachyphyllum,* Hemsl.; *secundum,* Klotzsch.

From South America; *affine,* Klotzsch; *Alaternoides,* H. B. & K.; *caracasanum,* H. B. & K.; *didymanthum,* Dun., (Rusby)[2]; *floribundum,* H. B. & K., (Rusby); *penæoides,* H. B. & K., (Rusby); *pernettyoides,* Griseb. (Rusby).

From the West Indies: *assimile* Wright; *Cubense* Griseb.; *meridionale* Sw; *Poasanum,* Donn. Sm.[3]

THE OUTLOOK.

As has been shown, the vacciniums are widely distributed, particularly in eastern and northern United States and Canada; and there are vast areas which, while bearing a considerable number of bushes and yielding a profitable return to the few people who make a practice of gathering the wild fruit, are not utilized as they might be. The systematic treatment of the wild lands as described in the foregoing pages might with profit be extended to many other sections.

There are also large areas, otherwise worthless, which might

[1] Professor Mohr in a personal letter to the writer states that he will raise this variety to specific rank in a forthcoming work—Alabama Plant Life.

[2] Collected by Rusby, Torr. Bul. 20:138.

[3] Species described by Donnel Smith in Bot. Gaz. 24:395, 1897.

without doubt be made to yield good returns if, in some way, a growth of blueberries could be started—either by setting bushes or by scattering seed. The most valuable species for this purpose are *Pennsylvanicum, Canadense,* and *vacillans.* Although this suggestion may be regarded as visionary, it is quite within the range of possibilities.

Another phase of the subject which is worthy of careful attention is that of domestication and the improvement of types by selection. During the last half century the cultivation of the cranberry has become an important and well established industry and several valuable types have been produced. Little has ever been attempted, however, in the garden culture of the blueberry; though there is no doubt that satisfactory results may be obtained. The fruit in its wild state is far superior to that of most other small fruits and is very susceptible to the influence of environment. At the Maine Agricultural Experiment Station systematic cultural experiments are now in progress and in Massachusetts cultivation has been practiced by amateurs with encouraging results. The most promising species for this purpose, as well as for ornamental planting, is the high-bush blueberry *Vaccinium corymbosum.* The natural varieties and improved forms of this species may readily be perpetuated by division or by grafting.

In general, it is probable that within a very few years a race of garden blueberries, rivaling in importance some of the best of the other small fruits, will be placed before the public, and the culture of the blueberry will be as much a matter of course as is that of the blackberry or the raspberry.

BIBLIOGRAPHY.

The literature of the Vacciniums is fragmentary and widely scattered. No attempt has been made to collate all of the references to the genus, but below is given a list of the more important monographs which are usually accessible in this country, together with the leading articles in horticultural books and journals.

Monographs and Floras.

AITON, W. T. Hortus Kewensis ed. 2, 5 vols., 1810-13. See 2: 355-9.

BIGELOW, JACOB. Florula Bostoniensis, ed. 2, 1824, see pp. 150-4.

BRITTON, N. L. and BROWN, A. Illustrated Flora of the Northern States and Canada, 3 vols., New York, 1897. See 2: 575-80.

CHAPMAN, A. W. Flora of the Southern United States, ed. 2, 1883. See pp. 259-60.

CLARKE, C. B. Vaccinium, in Hooker, Flora of British India, 7 vols., 1882. See 3: 451-5.

DON, GEORGE. Dictionary of Gardening and Botany, 4 vols., 1831-38. See 3: 855-860.

DUNAL, MICHEL FELIX. Vaccinium, in De Candolle, Prodromus, 7: 566-576, 1839.

GRAY, ASA. Synoptical Flora of North America, 2: 20-26, 1887.

H. B. and K. (HUMBOLDT, BONPLAND and KUNTH). Voyage de Humboldt et Bonpland, 8 vols., 1815-25. See 3: 265 et seq.

HEMSLEY, W. BOTTING. Biologia centrali-americana, Botany (1879-88), 5 vols. See 2: 30 et seq.

HOOKER, WILLIAM JACKSON. Flora boreali-americana, etc., London, 1829-40, 2 vols. See 2: 33 et seq.

HUMBOLDT, FRIEDRICH HEINRICH ALEXANDER VON, see H. B. and K.

KOCH, KARL HEINRICH EMIL. Dendrologie. Bäume . . . welche in Europa . . . kultivirt werden, 1869, 3 vols. See 2: 95-109.

KUNTH, CARL SIGISMUND, see H. B. and K.

LAMARCK, JEAN BAPTISTE ANTOINE. Encyclopedie methodique Botanique, Paris, 1783-1808, 8 vols. See 1: 63 et seq.

MICHAUX, ANDRE. Flora boreali-americana, Paris, 1803 (ed. 2, 1820), 2 vols. See 1: 227-235.

NUTTALL, THOMAS. Transactions of American Philosophical Society, ser 2, 8: 261 et seq., 1842.

PURSH, FREDERICK. Flora Americanae-septentrionalis . . . London, 1814, 2 vols. See 2: 284-290.

Current Literature.

AMES, MARCUS F. The Culture of Blueberries. Am. Cult. Aug. 1898.

ASCHERSON and MAGNUS. Die weissfrüchtige Heidelbeere. Verhandl. Zool. Bot. Gesell., Vienna, 1891, 679.

ASCHERSON and MAGNUS. "Die Weisse Heidelbeere (*Vaccinium Myrtillus,* L. var. *leucocarpa,* Hause), nicht identische mit der durch *Sclerotinia baccarum* (Sch.) Rehm, verursachten Sclerotien Krankheit." Ber. der deutschen Bot. Gesellsch., 1890, 387-400.

BAILEY, L. H. Cape Cod Cranberries. Am. Gard. 11: 583-6, 1890. Cultural notes.

BONGARD, HEINRICH GUSTAV, Sitk. 525, "Observations sur la vegetation de l'ile de Sitcha." Mem. Acad. Petersb. Ser. VI, II, (St. Petersburg, 1833)

CARD, F. W., "Huckleberries," Bush Fruits, 491-501.

DAWSON, JACKSON, "Huckleberries and Blueberries." Count. Gent., 1885, p. 660. Detailed notes on the culture of seedlings of this class.

DAWSON, JACKSON, The Cultivation of Huckleberries. Gard. and For. 1: 183-185, 1888.

FERNALD, M. L., The Distribution of the Bilberries of New England. Rhodora, 2: 187-190, 1900. Refers particularly to *V. cæspitosum* and *V. uliginosum.*

FARLOW, W. G., White Huckleberries. Gard. and For. 2: 50 and 6: 363.

FULLER, A. S., Huckleberries. Small Fruit Culturist, ed. 1, 245-250.

GERARDE, JOHN, Herballe, ed. 2, pp. 1415-19, figs. 6, 1633. Interesting historical notes.

HARVEY, F. L., The Cranberries of Maine. Trans. Maine Pom. Soc'y 1895, 49-54.

HILL, E. J., *V. vacillans* with White Fruit. Gard. and For. 8: 503, 1895.

JACK, J. G., The Cultivated Blueberries. Gard. and For. 7: 294, 1894.

LAWTON, C. D., The Value of Huckleberry Swamps, Rep. Mich. Hort. Soc'y, 1881, 231.

MACOUN, J. M., Notes on *V. Vitis-Idaea.* Gard. and For. 2: 508, 1889.

MAURY, PAUL, "Vaccinium de France—sur les variations de Structure des." Jour. de Bot. 1: 104-8, 115-117, ill.

MUNSON, W. M., The Blueberry in Maine. Rep. Maine Agr'l Exp. Sta. 1898, 164-172.

MUNSON, W. M., Some Little Known Fruits. Am. Gard. 20: 852, 1899. (Same, Trans. Me. Pom. Soc'y 1899, 36-38)

MUNSON, W. M., The Blueberry—Its Past, Present, and Future.

PARKINSON, JOHN, Whortleberries. Theatrum Botanicum, Chap. 46, pp. 1455-9, 1640.

PECK, CHAS. H., Huckleberries and Blueberries. Count. Gent. 1888, p. 168. Popular notes on the botany of several species of *Vaccinium* and *Gaylussacia.*

SARGENT, C. S., Notes on *Vaccinium hirsutum.* Gard. and For. 2: 364, fig. 1, 1899.

STURTEVANT, E. LEWIS, Huckleberries and Blueberries—Gaylussacia and Vaccinium, sp. Trans. Mass. Hort. Soc'y 1890, pp. 17-38.

WORONIN, Ueber die Sclerotien Krankheit der Vaccinieen Beeren, 1888.

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FERTILIZER INSPECTION.

CHAS. D. WOODS, Director.

J. M. BARTLETT, Chemist in charge of Fertilizer Analysis.

The law regulating the sale of commercial fertilizers in this State calls for two bulletins each year. The first of these contains the analyses of the samples received from the manufacturer guaranteed to represent, within reasonable limits, the goods to be placed upon the market later. The second bulletin contains the analyses of the samples collected in the open market by a representative of the Station.

The analyses of the manufacturer's samples for this year were published early in March. The present bulletin contains the analyses of the samples collected by the representative of the Director of the Station.

The figures which are given as the percentages of valuable ingredients guaranteed by the manufacturers are the minimum percentages of the guarantee. If, for instance, the guarantee is 2 to 3 per cent of nitrogen, it is evident that the dealer cannot be held to have agreed to furnish more than two per cent and so this percentage is taken as actual guarantee. The figures under the head of "found" are those showing the actual composition of the samples.

A comparison of the results of the analyses of the samples collected by the Station with the percentages guaranteed by the manufacturers shows, that, as a rule, the fertilizers sold in the State are well up to the guarantee. In a few instances the particular lots of fertilizers sampled are not quite as good as they should be; there is, however, no case which appears to be an attempt to defraud. The comparisons indicate that the manufacturers do not intend to do much more than make good the minimum guarantee and this is all that the purchaser can safely expect.

DESCRIPTIVE LIST OF STATION SAMPLES, 1901.

Station number.	Manufacturer, place of business and brand.	Sampled at
	AMERICAN AGR. CHEM. CO., NEW YORK, N. Y.	
2621	Bradley's Complete Manure for Potatoes and Vegetables	Orland
2622	Bradley's Complete Manure with 10% Potash.	Houlton
2624	Bradley's Corn Phosphate	Portland
2623	Bradley's Eureka Fertilizer	Portland
2772	Bradley's Niagara Phosphate	Calais.
2625	Bradley's Potato Fertilizer.	Portland
2626	Bradley's Potato Manure.	Portland
2627	Bradley's X. L. Superphosphate	Portland
2628	Clark's Cove Bay State Fertilizer	Portland
2629	Clark's Cove Bay State Fertilizer G. G.	Portland
2762	Clark's Cove Great Planet Manure.	Linneus
2631	Clark's Cove King Philip Alkaline Guano	Portland
2630	Clark's Cove Seeding Down Fertilizer	Portland
2632	Cleveland High Grade Complete Manure	Bangor
2633	Cleveland Potato Phosphate	Bangor
2634	Cleveland Seeding Down Fertilizer	Portland
2635	Cleveland Superphosphate	Portland
2636	Crocker's Corn Phosphate	Portland
2637	Crocker's Grass and Oats Fertilizer	Portland
2638	Crocker's New Rival Ammoniated Superphosphate	Portland
2639	Crocker's Potato, Hop and Tobacco Fertilizer	Portland
2640	Cumberland Potato Fertilizer	Portland
2641	Cumberland Seeding Down Manure	Portland
2642	Cumberland Superphosphate	Portland
2643	Darling's Blood Bone and Potash	Houlton
2644	Great Eastern General Fertilizer	Portland
2645	Great Eastern Grass and Oats Fertilizer	Portland
2646	Great Eastern High Grade Potato Manure	Caribou
2647	Great Eastern Northern Corn Special	Portland
2648	Great Eastern Potato Manure	Portland
2746	Otis Potato Fertilizer	Hallowell
2747	Otis Seeding Down Fertilizer	Hallowell
2748	Otis Superphosphate	Hallowell
2749	Pacific Grass and Grain Fertilizer	Dexter
2756	Pacific High Grade General Fertilizer	Fort Fairfield

ANALYSIS OF STATION SAMPLES, 1901.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
			Total.					Available.		Total.			
	Soluble in water.	Insoluble in water.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	%	%	%	%	%	%	%	%	%	%	%	%	%
2621	2.18	1.37	3.55	3.30	4.91	3.87	1.95	8.78	8	10.73	8	7.48	7
2622	1.50	1.79	3.29	3.30	3.92	3.22	3.19	7.14	6	10.33	7	9.60	10
2624	.77	1.71	2.48	2.06	5.04	3.27	3.86	8.31	8	12.17	10	1.88	1.5
2623	.42	1.49	1.91	1.03	3.06	3.34	4.31	6.42	8	10.73	9	2.57	2
2772	.34	1.21	1.55	.82	4.82	3.32	2.58	8.14	7	10.72	8	1.85	1.08
2625	.88	1.19	2.07	2.06	5.63	2.54	2.36	8.17	8	10.53	10	3.46	3
2626	.80	1.91	2.81	2.50	3.30	3.48	3.72	6.78	6	10.50	7	5.30	5
2627	.92	1.59	2.51	2.50	6.51	3.21	2.15	9.72	9	11.87	11	2.28	2
2628	1.08	1.43	2.51	2.50	7.05	3.14	1.80	10.19	9	11.99	11	2.87	2
2629	.79	1.55	2.34	2.06	5.15	3.53	3.14	8.68	8	11.82	10	1.86	1.5
2762	1.55	1.47	3.02	3.30	5.74	2.95	3.13	8.69	8	11.72	9	7.29	7
2631	.40	.95	1.35	1.03	5.89	2.36	2.87	8.25	8	11.12	10	2.56	2
2630	.56	.72	1.28	1.03	2.36	8.82	1.05	11.18	8	12.23	10	1.62	2
2632	2.05	1.27	3.32	3.30	6.06	3.23	1.16	9.29	8	10.45	9	7.18	7
2633	.52	1.51	2.03	2.06	6.08	2.95	1.37	9.03	8	10.40	10	3.08	3
2634	.19	1.11	1.30	1.03	5.31	3.61	1.34	8.92	8	10.26	10	2.00	2
2635	.83	1.33	2.16	2.06	4.61	4.41	2.56	9.02	8	11.58	10	1.73	1.5
2636	.75	1.31	2.06	2.06	5.81	2.32	2.56	8.13	8	10.69	10	1.94	1.5
2637	.....	.....	.....	.....	5.87	5.26	2.46	11.13	11	13.59	12	2.18	2
2638	.60	1.31	1.91	1.03	4.58	3.59	2.09	8.18	8	10.27	10	2.79	2
2639	.72	1.34	2.06	2.06	5.38	2.64	2.14	8.02	8	10.16	10	3.08	3
2640	.73	1.34	2.07	2.06	4.42	4.51	1.98	8.93	8	10.91	10	2.82	3
2641	.29	1.05	1.34	1.03	5.58	3.26	2.12	8.84	8	10 96	10	2.34	2
2642	.85	1.21	2.06	2.06	4.37	4.42	3.11	8.79	8	11.90	10	1.98	1.5
2643	2.72	1.43	4.15	4.10	4.50	3.65	1.29	8.15	7	9.44	8	7.86	7
2644	.21	1.15	1.36	.82	5.31	3.59	1.91	8.80	8	10.81	10	4.14	4
2645	.....	.....	.....	.....	4.88	6.07	2.86	11.05	11	13.91	12	2.03	2
2646	1.86	1.71	3.67	3.30	3.86	2.85	1.74	6.71	6	8.45	.....	10.04	10
2647	.67	1.41	2.08	2.06	3.99	5.46	2.82	9.45	8	12.27	10	2.18	1.5
2648	.78	1.31	2.09	2.06	4.94	3.80	2.31	8.74	8	11.05	10	3.51	3
2746	1.08	.92	2.00	2.06	7.02	2.06	2.74	9.08	8	11.82	10	3.45	3
2747	.56	.59	1.15	1.03	5.85	2.36	2.57	8.21	8	10.78	10	2.33	2
2748	1.28	.81	2.09	2.06	6.76	2.00	2.84	8.76	8	11.60	10	2.03	1.5
2749	.21	.97	1.18	.82	3.99	3.51	2.87	7.50	7	10.37	8	1.93	1
2756	1.52	1.45	2.97	2.30	6.70	2.39	3.06	9.09	8	12.15	9	7.19	7

DESCRIPTIVE LIST OF STATION SAMPLES, 1901.

Station number.	Manufacturer, place of business and brand.	Sampled at
2649	Pacific Nobsque Guano	Portland
2650	Pacific Potato Special	Portland
2651	Soluble Pacific Guano.	Portland
2652	Soluble Pacific Guano with 10% Potash	Ft. Fairfield
2653	Packer's Union Animal Corn Fertilizer	Portland
2654	Packer's Union Economical Vegetable Guano	Bangor
2655	Packer's Union Gardener's Complete Manure	Houlton
2656	Packer's Union Potato Manure	Portland
2657	Packer's Union Universal Fertilizer	Portland
2658	Packer's Union Wheat, Oats and Clover Fertilizer	Portland
2659	Quinnipiac Corn Manure	Portland
2660	Quinnipiac Market Garden Manure	Ft. Fairfield
2771	Quinnipiac Mohawk Fertilizer	Gray
2661	Quinnipiac Potato Manure	Portland
2662	Quinnipiac Potato Phosphate	Portland
2663	Quinnipiac Seeding Down Manure	Portland
2664	Quinnipiac Special with 10% Potash	Ft. Fairfield
2665	Read's Potato Manure	Ft. Fairfield
2666	Read's Practical Potato Special	Ft. Fairfield
2667	Read's High Grade Farmer's Friend	Ft. Fairfield
2668	Read's Vegetable and Vine Fertilizer	Ft. Fairfield
2669	Standard A. Brand	Portland
2670	Standard Fertilizer	Portland
2671	Standard Guano	Portland
2672	Williams and Clark's Americus Am'n'ted Bone Sup'rphos'ate	Portland
2673	Williams and Clark's Americus Corn Phosphate	Portland
2675	Williams and Clark's Americus with 10% Potash	Ft. Fairfield
2674	Williams and Clark's Americus Potato Manure	Portland
2676	Williams and Clark's Americus Potato Manure	Portland
2677	Williams and Clark's Potato Phosphate	Portland
2678	Williams and Clark's Royal Bone Phosphate for all Crops	Portland

ANALYSES OF STATION SAMPLES, 1901.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total.		Soluble.	Reverted.	Insoluble.	Available.		Total.		Found.	Guaranteed.
			Found.	Guaranteed.				Found.	Guaranteed.	Found.	Guaranteed.		
	%	%	%	%	%	%	%	%	%	%	%	%	%
2649	.35	1.29	1.64	1.03	5.90	3.51	2.41	9.41	8	11.82	10	2.55	2
2650	.74	1.43	2.17	2.06	5.42	3.80	1.75	9.22	8	10.97	10	3.04	3
2651	.63	1.85	2.48	2.06	5.87	2.70	3.19	8.57	8	11.76	10	1.88	1.5
2652	1.68	1.59	3.27	2.47	3.21	3.36	2.82	6.57	6	9.39	7	8.94	10
2653	1.13	1.59	2.72	2.47	6.14	2.80	2.22	8.94	9	11.16	11	2.57	2
2654	.49	1.31	1.80	1.25	2.11	4.45	3.30	6.56	6	9.86	7	3.27	3
2655	1.28	1.03	2.31	2.47	3.86	2.74	1.53	6.60	6	8.13	7	10.87	10
2656	.79	1.29	2.08	2.06	5.20	2.88	1.87	8.08	8	9.95	10	7.95	6
2657	.17	1.15	1.32	.82	4.96	3.22	2.01	8.18	8	10.19	10	4.17	4
2658	.....	.....	.....	.....	5.15	5.34	3.21	10.49	11	13.70	12	1.99	2
2659	.53	1.91	2.44	2.06	5.50	2.34	3.84	7.84	8	11.68	10	1.90	1.5
2660	1.72	1.47	3.19	3.30	5.81	2.74	1.96	8.55	8	10.51	9	6.69	7
2771	.85	.83	1.68	.82	2.07	5.45	4.00	7.52	7	11.52	8	1.37	1
2661	1.16	1.35	2.51	2.50	3.19	2.53	3.91	5.72	6	9.63	8	5.79	5
2662	.25	2.05	2.30	2.06	5.82	2.36	2.57	8.18	8	10.75	10	3.48	3
2663	.32	1.17	1.49	1.03	4.15	4.96	2.55	9.11	8	11.66	10	2.51	2
2664	.99	1.27	2.26	2.47	4.43	2.07	1.75	6.50	6	8.25	7	10.41	10
2665	.96	1.27	2.23	2.47	4.10	2.50	1.60	6.60	6	8.20	7	10.59	10
2666	.19	1.13	1.32	.82	2.58	2.08	2.55	4.66	4	7.21	5	9.22	8
2667	1.82	1.43	3.25	3.30	4.47	2.61	2.23	7.08	6	9.31	7	9.55	10
2668	.90	1.25	2.15	2.06	5.50	2.49	1.93	7.99	8	9.92	10	6.92	6
2669	.13	.90	1.03	.82	2.50	5.06	3.35	7.56	7	10.91	8	1.46	1
2670	.78	1.49	2.27	2.06	4.80	3.27	3.48	8.07	8	11.55	10	1.85	1.5
2671	.30	1.17	1.47	1.03	6.62	2.88	2.14	9.50	8	11.64	10	2.51	2
2672	1.25	1.17	2.42	2.50	6.76	3.00	1.34	9.76	9	11.10	11	2.52	2
2673	.53	1.87	2.40	2.06	5.82	3.53	2.60	9.35	8	11.95	10	1.95	1.5
2675	.82	1.61	2.43	2.47	3.49	2.67	2.36	6.16	6	8.52	7	11.03	10
2674	.89	1.19	2.08	2.06	5.82	2.84	1.88	8.66	8	10.54	10	3.09	3
2676	.81	1.45	2.26	2.06	5.97	2.44	2.28	8.41	8	10.69	10	3.49	3
2677	1.02	1.27	2.29	2.50	3.46	2.75	3.46	6.21	6	9.67	8	5.68	5
2678	1.3	1.29	1.42	1.03	6.87	3.61	1.82	10.48	8	12.30	10	2.16	2

DESCRIPTIVE LIST OF STATION SAMPLES, 1901.

Station number.	Manufacturer, place of business and brand.	Sampled at
	THE BOWKER FERTILIZER CO., BOSTON, MASS.	
2679	Bowker's Corn Phosphate	Portland
2680	Bowker's Early Potato Manure	Portland
2774	Bowker's Early Potato Manure	Houlton
2681	Bowker's Farm and Garden Phosphate	Portland
2682	Bowker's Hill and Drill Phosphate	Portland
2683	Bowker's Market Garden Fertilizer	Houlton
2684	Bowker's Potash Bone	Belfast
2690	Bowker's Potash or Staple Phosphate	Houlton
2685	Bowker's Potato and Vegetable Fertilizer	Houlton
2686	Bowker's Potato and Vegetable Phosphate	Houlton
2687	Bowker's 6% Potato Fertilizer	Houlton
2689	Bowker's Square Brand Bone and Potash	Houlton
2692	Bowker's Sure Crop Phosphate	Portland
2696	Bowker's 10% Manure	Presque Isle
2694	Gloucester Fish and Potash	Belfast
2695	Stockbridge Corn and Grain Manure	Portland
2697	Stockbridge Potato and Vegetable Manure	Portland
2698	Stockbridge Seeding Down Manure	Belfast
	E. FRANK COE CO., NEW YORK CITY, N. Y.	
2730	E. Frank Coe's Celebrated Special Potato Fertilizer	Portland
2732	E. Frank Coe's Columbian Corn Fertilizer	Portland
2731	E. Frank Coe's Columbian Phosphate	Belfast
2733	E. Frank Coe's Columbian Phosphate	Portland
2734	E. Frank Coe's Columbian Potato Fertilizer	Belfast
2735	E. Frank Coe's Excelsior Potato Fertilizer	Belfast
2736	E. Frank Coe's Famous Grass and Grain Fertilizer	Belfast
2739	E. Frank Coe's Ground Bone and Potash	Belfast
2740	E. Frank Coe's High Grade Ammoniated Bone Superphosphate	Belfast
2741	E. Frank Coe's High Grade Potato Fertilizer	Portland
2742	E. Frank Coe's New Englander Corn Fertilizer	Portland
2743	E. Frank Coe's New Englander Potato Fertilizer	Belfast
2738	E. Frank Coe's Prize Brand Grain and Grass Fertilizer	Belfast
2744	E. Frank Coe's Original Ammon. Dissolved Bone Phosphate	Belfast
2737	E. Frank Coe's Red Brand Excelsior Guano	Portland
2745	E. Frank Coe's Standard Grade Ammon. Bone Superphosphate	Belfast
	HENRY ELWELL & CO., NEW YORK, N. Y.	
2699	Elwell's Eureka Fertilizer	Presque Isle
2700	Elwell's Excelsior Potato Fertilizer	Presque Isle
	LISTER'S AGRICUL. CHEM. WORKS, NEWARK, N. J.	
2701	Lister's Animal Bone and Potash No. 2	Portland
2702	Lister's High Grade Special for Spring Crops	Fort Fairfield
2703	Lister's Seeding Down Fertilizer	Portland
2704	Lister's Special Corn and Potato Fertilizer	Portland
2705	Lister's Success Fertilizer	Portland
2706	Lister's U. S. Superphosphate	Portland

ANALYSES OF STATION SAMPLES, 1901.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
			Total.					Available.		Total.			
	Soluble in water.	Insoluble in water.	Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	%	%	%	%	%	%	%	%	%	%	%	%	%
2679	.63	.93	1.56	1.50	6.64	2.73	1.24	9.37	8	10.61	10	2.31	2
2680	1.33	1.47	2.79	3.00	4.78	3.64	1.04	8.42	7	9.46	9	7.37	7
2774	.98	1.83	2.81	3.00	3.92	3.23	3.52	7.15	7	10.67	9	7.35	7
2681	.36	1.11	1.47	1.50	5.93	2.79	1.91	8.71	9	10.62	11	2.54	2
2682	.84	1.35	2.19	2.25	5.12	4.23	3.08	9.41	9	12.44	11	2.23	2
2683	1.00	1.27	2.27	2.25	4.98	2.50	2.03	7.48	6	9.51	7	10.85	10
2684	.18	.81	.99	.75	3.46	6.19	3.14	9.65	6	12.79	8	1.22	2
2690	.21	.67	.88	.75	4.59	3.35	3.13	7.94	8	11.07	10	5.38	3
2685	.71	1.39	2.10	2.25	6.89	3.28	2.14	10.17	9	12.31	10	4.60	4
2686	.10	1.43	1.53	1.50	3.99	4.99	3.51	8.38	9	12.49	11	2.06	2
2687	.49	.41	.90	.75	4.15	4.16	2.52	8.31	6	10.83	9	6.59	6
2689	.16	1.37	1.53	1.50	.96	5.79	6.86	6.75	6	13.61	12	2.28	2
2692	.29	.61	.90	.75	5.84	3.06	1.80	8.90	9	10.70	11	1.96	2
2693	.16	.59	.75	.75	3.83	3.72	2.71	7.55	5	10.26	7	9.67	10
2694	.28	.55	.83	.75	2.04	4.16	2.65	6.20	6	8.85	9	2.20	1
2695	1.22	1.61	2.83	3.00	4.63	3.19	1.56	7.82	7	9.38	9	7.18	7
2697	1.36	1.51	2.87	3.00	5.66	1.74	1.34	7.40	6	8.74	8	10.50	10
2698	1.04	1.23	2.27	2.25	5.15	2.57	2.20	7.72	6	9.92	10	10.04	10
2730	.91	.91	1.82	1.65	6.67	2.10	1.61	8.77	8	10.38	9.5	4.07	4
2732	.71	.71	1.42	1.20	6.79	2.73	2.38	9.52	8.50	11.90	10	2.99	2.5
2731	.45	1.19	1.64	1.20	5.09	3.33	3.32	8.42	8.50	11.74	10	3.51	2.5
2733	.59	.95	1.54	1.20	6.44	2.97	2.87	9.41	8.50	12.28	10	2.60	2.5
2734	.29	.97	1.26	1.20	4.50	4.26	3.65	8.76	8.50	12.41	10	2.43	2.5
2735	1.27	1.19	2.46	2.40	6.06	2.06	2.28	8.12	7	10.40	8.5	8.61	8
2736	.45	.57	1.02	.80	4.07	4.52	3.24	8.59	8.50	11.83	10	1.87	1.50
2739	.55	1.11	1.66	2.00	.22	4.92	9.47	5.14	.....	14.61	14	3.16	2
2740	.28	1.43	1.71	1.85	6.76	2.73	1.80	9.49	9	11.29	13	2.51	2.25
2741	.86	1.45	2.31	2.40	6.35	2.02	1.90	8.37	7.50	10.27	8.5	6.07	6
2742	.45	.75	1.20	.80	4.88	3.56	3.25	8.44	7.50	11.69	9	3.20	3
2743	.50	.71	1.21	.80	4.91	3.43	3.19	8.34	7.50	11.53	9	3.26	3
2738	....	.....	.....	.....	4.90	5.09	3.73	9.99	10.50	13.72	12	2.06	2
2744	.36	.95	1.31	1.25	5.38	2.96	3.64	8.34	9	11.98	10	2.75	2.25
2737	1.75	1.31	3.06	3.40	5.74	3.29	2.44	9.03	9	11.47	10.5	7.24	6
2745	.82	.67	1.49	1.50	7.02	2.39	2.30	9.41	8.50	11.71	10	2.44	2
2699	.96	1.01	1.97	2.00	5.60	1.99	2.09	7.59	7.00	9.68	8.5	6.83	7
2700	1.27	1.35	2.62	2.85	4.66	1.97	2.06	6.63	5.50	8.69	7	9.89	10
2701	.....	.....	.....	.....	7.73	2.00	1.69	9.73	10	11.42	11	2.53	2
2702	.58	1.01	1.59	1.65	6.54	2.20	1.71	8.74	8	10.45	10	10.83	10
2703	.25	.85	1.10	.83	4.04	3.66	2.57	7.70	7	10.27	8	1.92	1
2704	.28	1.37	1.65	1.65	4.55	3.95	2.65	8.50	8	11.15	9	3.33	3
2705	.21	1.05	1.26	1.24	5.66	3.96	2.57	9.62	9	12.19	11	2.39	2
2706	.33	1.33	1.66	1.03	5.76	3.62	2.42	9.38	8	11.80	10	2.30	2

DESCRIPTIVE LIST OF STATION SAMPLES, 1901.

Station number.	Manufacturer, place of business and brand.	Sampled at
	LOWELL FERTILIZER CO., BOSTON, MASS.	
2763	Swift's Lowell Animal Brand	Bangor
2764	Swift's Lowell Bone Fertilizer	Bangor
2765	Swift's Lowell Dissolved Bone and Potash	Bangor
2766	Swift's Lowell Ground Bone	Bangor
2768	Swift's Lowell Potato Manure	Bangor
2769	Swift's Lowell Potato Phosphate	Bangor
	NEW ENGLAND FERTILIZER CO., BOSTON, MASS.	
2707	New England Corn Phosphate	Portland
2708	New England High Grade Truck Fertilizer	
2709	New England Potato Fertilizer	Portland
	NATIONAL FERTILIZER CO., BRIDGEPORT, CONN.	
2710	Chittenden's Ammoniated Bone Phosphate	Ft. Fairfield
2711	Chittenden's Complete Fertilizer	Houlton
2712	Chittenden's Market Garden Fertilizer	Houlton
2775	Chittenden's Market Garden Fertilizer	Presque Isle
	PARMENTER & POLSEY FERT. CO., PEABODY, MASS.	
2713	A. A. Brand Fertilizer	Presque Isle
2714	P. & P. Potato Fertilizer	Presque Isle
2715	Plymouth Rock Brand Fertilizer	Presque Isle
2716	Special Potato Fertilizer	Presque Isle
	EDWIN J. PHILBRICK, AUGUSTA, ME.	
2750	E. J. Philbrick's High Grade Fertilizer	Augusta
	PORTLAND RENDERING CO., PORTLAND, ME.	
2717	Portland Rendering Co.'s Bone Tankage	Portland
	PROVINCIAL CHEMICAL CO., L't'd, St. John, N. B.	
2718	Provincial Chemical Co.'s Special Potato Phosphate	Presque Isle
	RUSSIA CEMENT CO., GLOUCESTER, MASS.	
2719	Essex A1 Superphosphate	Bangor
2720	Essex Complete Manure for Potatoes, Roots and Vegetables	Houlton
2758	Essex Corn Fertilizer	Dexter
2721	Essex Market Garden Potato Manure	Bangor
2722	Essex Special Potato Fertilizer for Aroostook Co	Ft. Fairfield
2723	Essex XXX Fish and Potash	Bangor
2751	Maine State Grange Chemicals	Dexter
2724	Maine State Grange Potato Manure	Houlton
2752	Maine State Grange Seeding Down Fertilizer	Dexter
	SAGADAHOC FERTILIZER CO., BOWDOINHAM, ME.	
2725	Aroostook Potato Manure	Bangor
2726	Dirigo Fertilizer	Caribou
2754	Sagadahoc Special Potato Fertilizer	Bowdoinham
2728	Sagadahoc Superphosphate	Bangor
2755	Yankee Fertilizer	Bowdoinham
	JOHN WATSON, HOULTON, ME.	
2729	Watson's Improved High Grade Potato Manure	Houlton

ANALYSES OF STATION SAMPLES, 1901.

Station number.	Nitrogen.				Phosphoric Acid.							Potash.	
	Soluble in water.	Insoluble in water.	Total.		Soluble.	Reverted.	Insoluble.	Available.		Total.		Found.	Guaranteed.
			Found.	Guaranteed.				Found.	Guaranteed.	Found	Guaranteed.		
	%	%	%	%	%	%	%	%	%	%	%	%	%
2763	.57	2.29	2.86	2.46	6.38	1.80	2.73	8.18	9	10.91	10	3.98	4
2764	.61	1.37	1.98	1.64	3.19	4.10	2.57	7.29	8	9.86	9	3.17	3
2765	.82	1.05	1.87	1.64	6.09	3.59	2.03	9.68	9	11.71	10	2.20	2
2766	.27	1.45	1.72	2.47	.35	14 83	14.87	15.18	5	30.05	23	.....	.....
2768	.66	1.29	1.95	1.64	2.36	5.25	2.79	7.61	7	10.40	8	4.56	4
2769	.98	1.83	2.81	2.47	6.44	1.46	1.83	7.90	8	9.73	9	6.48	6
2707	.76	1.15	1.91	1.64	2.74	5.36	2.22	8.10	8	10.32	9	3.61	3
2708	1.20	2.19	3.39	3.30	3.97	2.11	1.24	6.08	6	7.32	7	10.32	10
2709	.48	1.29	1.77	1.64	1.44	6.65	1.80	8.09	7	9.89	8	4.52	4
2710	.39	1.49	1.88	1.65	7.21	2.96	2.06	10.17	8	12.23	9	2.84	2
2711	.36	3.11	3.47	3.00	5.95	2.18	1.61	8.13	8	9.74	10	6.79	6
2712	1.18	1.27	2.45	2.45	5.28	2.12	2.22	7.40	6	9.62	8	5.48	5
2775	.42	2.23	2.65	2.45	5.12	3.03	3.03	8.15	6	11.18	8	6.14	5
2713	2.71	1.83	4.54	4.53	3.99	4.93	.59	8.92	7	9.51	8	8.84	8
2714	.48	1.27	1.75	1.64	1.99	4.37	3.96	6.36	6	10.32	7	6.50	6
2715	1.28	1.43	2.71	2.47	2.34	6.19	2.92	8.53	8	11.45	9	5.00	4
2716	2.07	1.29	3.36	3.29	3.22	5.25	2.17	8.47	8	10.64	9	7.55	7
2750	.76	1.11	1.87	2.00	3.73	3.70	2.78	7.43	7	10.21	9	4.90	5
2717	.70	3.87	4.57	4.27	.45	8.87	9.55	9.32	7.34	18.87	19.40	.....	.....
2718	1.62	1.69	3.31	3.25	6.51	1.93	5.98	8.44	8.00	14.42	10	3.41	6
2719	.13	1.01	1.14	1.00	.80	5.53	4.91	6.33	7.00	11.24	9	2.02	2
2720	1.05	3.15	4.20	3.70	5.04	3.77	1.72	8.81	7	10.53	9	9.15	8.50
2753	.23	1.85	2.08	2.00	2.79	5.54	4.40	8.33	9	12.73	11	3.05	3
2721	.76	1.63	2.39	2.00	2.79	5.31	3.32	8.10	8	11.42	10	6.09	5
2722	.65	1.85	2.50	2.50	1.96	5.49	3.62	7.45	7	11.07	9	6.03	5
2723	.56	1.91	2.47	2.10	2.55	5.58	4.82	8.13	9	12.95	12	2.76	2.25
2751	1.02	1.53	2.55	2.50	4.34	4.97	3.19	9.31	8	12.50	12	4.45	4
2724	.77	.91	1.68	1.50	4.55	5.53	2.55	10.08	9	12.63	12	12.69	12
2752	.16	1.57	1.73	1.50	1.75	6.29	5.34	8.04	7	13.38	13	5.27	5.50
2725	.77	.59	1.36	1.25	5.14	2.17	.81	7.31	5	8.12	6	4.01	2.50
2726	.30	.89	1.19	1.50	4.42	3.34	4.98	7.76	7	12.74	11	2.73	3
2754	.87	1.27	2.14	2.50	1.72	4.15	.30	5.87	6	6.17	8	10.93	7
2728	1.04	1.05	2.09	2.00	4.50	3.87	1.63	8.37	7	10.00	9	3.86	3
2755	.46	.69	1.15	.50	1.44	3.84	1.99	5.28	3	7.27	5	1.26	.....
2729	1.20	1.97	3.17	.3	2.12	4.24	3.67	6.36	6	10.03	7	6.02	5

COMPARISON OF GUARANTEES AND STATION SAMPLES FOR THREE YEARS.

Name of Fertilizer.	Nitrogen.				Available Phosphoric Acid.				Potash.			
	Found.			Guaranteed in 1901.	Found.			Guaranteed in 1901.	Found.			Guaranteed in 1901.
	1899.	1900.	1901.		1899.	1900.	1901.		1899.	1900.	1901.	
	%	%	%	%	%	%	%	%	%	%	%	%
Bradley's Complete Manure for Potatoes and Vegetables	*3.04	*3 06	3.55	3.30	*8.42	*8.70	8.78	8.0	*6.57	*7.41	7.48	7.0
Bradley's Complete Manure with 10% Potash	.....	.....	3.29	3.30	.....	.....	7.14	6.0	.....	.....	9.60	10.0
Bradley's Corn Phosphate	2.19	*2.19	2.48	†2.06	9.48	*9.41	8.31	†8.0	2.19	*1.96	1.88	1.50
Bradley's Eureka Fertilizer	1.93	1.20	1.91	1.03	5.48	8.18	6.42	8.0	2.16	2.25	2.57	2.0
Bradley's Niagara Phosphate	.....	1.15	1.55	.82	.....	8.31	8.14	7.0	.....	1.35	1.85	1.08
Bradley's Potato Fertilizer	2.58	*2.10	2.07	2.06	9.02	*8.90	8.17	†8.0	3.57	*3.18	3.46	†3.0
Bradley's Potato Manure	2.52	2.51	2.81	2.50	6.74	6.48	6.78	6.0	5.87	5.58	5.30	5.0
Bradley's X. L. Superphosphate	*2.28	2.51	2.51	2.50	*9.74	9.72	9.72	9.0	*2.38	2.32	2.28	2.0
Clark's Cove Bay State Fertilizer	2.62	2.50	2.51	†2.50	9.62	9.10	10.19	9.0	1.90	2.30	2.87	2.0
Clark's Cove Bay State Fertilizer, G.G	2.27	2.17	2.34	†2.06	9.06	9.65	8.68	†8.0	2.24	2.08	1.86	†1.50
Clark's Cove Defiance Complete Manure	1.12	1.29	.....	.82	8.35	9.08	....	7.0	1.20	1.80	.....	1.0
Clark's Cove Great Planet Manure	*2.82	.....	3.02	3.30	*7.52	.....	8.69	8.0	*7.13	.....	7.29	7.0
Clark's Cove King Philip Alkaline Guano	1.43	1.20	1.35	†1.03	8.09	8.49	8.25	†8.0	3.26	2.16	2.56	†2.0
Clark's Cove Seeding Down Fertilizer	1.13	1.13	1.28	1.03	8.88	9.10	11.18	8.0	2.61	2.47	1.62	2.0
Cleveland Fertilizer for All Crops	1.86	1.15	.....	1.03	8.17	9.37	.....	8.0	2.10	2.29	.....	2.0
Cleveland High Grade Complete Manure	.....	.....	3.32	3.30	.....	.....	9.29	8.0	.....	.....	7.18	7.0
Cleveland Potato Phosphate	2.26	2.24	2.03	2.06	8.53	8.52	9.03	8.0	2.86	3.29	3.08	3.0
Cleveland Seeding Down Fertilizer	2.08	1.23	1.30	1.03	9.80	8.65	8.92	8.0	2.32	2.39	2.00	2.0
Cleveland Superphosphate	2.14	2.07	2.16	2.06	8.82	8.68	9.02	†8.0	2.51	1.87	1.73	†1.50
Crockers's Corn Phosphate	*2.24	2.15	2.06	†2.06	*9.77	9.05	8.13	†8.0	*1.75	2.00	1.94	†1.50
Crocker's Grass and Oats Fertilizer	1.00	.....	.....	†.....	9.19	10.29	11.13	†11.0	2.81	2.11	2.18	2.0

Crocker's New Rival Ammoniated Superphosphate	*1.45	1.03	1.91	†1.03	*9.33	9.64	8.16	†8.0	*1.74	2.06	2.79	†2.0
Crocker's Potato, Hop and Tobacco Fertilizer	*2.21	*1.90	2.06	†2.06	*9.69	*9.01	8.02	†8.0	*3.29	*3.34	3.08	†3.0
Cumberland Guano	.....	.....	... .	1.03	.....	.....	.....	8.0	.....	.....	.....	2.0
Cumberland Potato Fertilizer	2.06	*2.08	2.07	2.06	9.00	*8.98	8.93	†8.0	2.90	*3.16	2.82	3.0
Cumberland Seeding Down Manure	1.20	1.24	1.34	1.03	8.67	8.69	8.84	8.0	2.43	2.27	2.34	2.0
Cumberland Superphosphate	2.06	2.14	2.06	2.06	8.89	9.05	8.79	8.0	2.63	2.32	1.98	†1.50
Darling's Blood, Bone and Potash	*3.60	3.78	4.15	4.10	*8.81	8.17	8.15	7.0	*7.23	7.24	7.96	†7.0
Great Eastern General Fertilizer	.94	1.02	1.36	.82	9.33	8.91	8.90	8.0	5.11	3.71	4.14	4.0
Great Eastern Grass and Oats Fertilizer	....	.....	.....	.....	11.61	10.17	11.05	11.0	1.80	1.97	2.03	2.0
Great Eastern High Grade Potato Manure	. ...	3.25	3.67	3.30	.....	6.98	6.71	6.0	.....	9.58	10.04	10.0
Great Eastern Northern Corn Special	3.09	2.12	2.08	†2.06	7.31	9.04	9.45	8.0	2.64	1.51	2.18	†1.50
Great Eastern Potato Manure	2.35	*1.97	2.09	2.06	8.27	*8.85	8.74	8.0	4.57	*3.26	3.51	†3.0
Otis Potato Fertilizer	2.33	2.06	2.00	†2.06	9.16	8.54	9.08	†8.0	3.52	3.16	3.45	3.0
Otis Seeding Down Fertilizer	1.26	1.14	1.15	†1.03	9.34	8.23	8.21	8.0	1.89	2.40	2.33	2.0
Otis Superphosphate	2.12	2.12	2.09	†2.06	9.89	8.36	8.76	†8.0	2.27	1.75	2.03	†1.50
Pacific Grass and Grain Fertilizer	1.24	1.24	1.18	.82	7.44	8.49	7.50	7.0	1.83	1.36	1.93	†1.0
Pacific High Grade General Fertilizer	.....	.....	2.97	3.30	.....	.....	9.09	8.0	.....	.....	7.19	7.0
Pacific Nobsque Guano	1.28	1.23	1.64	†1.03	8.89	8.43	9.41	8.0	2.49	2.22	2.55	2.0
Pacific Potato Special	2.11	2.08	2.17	2.06	10.40	9.00	9.22	8.0	3.25	2.97	3.04	3.0
Soluble Pacific Guano	*2.16	2.13	†2.48	2.06	*9.05	8.37	8.57	†8.0	*2.42	1.93	1.88	†1.50
Soluble Pacific Guano with 10% Potash	.....	.....	3.27	2.47	....	.....	6.57	6.0	.....	.....	8.94	10.0
Packer's Union Animal Corn Fertilizer	2.68	2.62	2.72	2.47	9.53	10.03	8.94	†9.0	2.23	2.86	2.37	2.0
Packer's Union Economical Vegetable Guano	....	1.21	1.80	1.25	.....	8.78	6.56	6.0	.....	3.25	3.27	3.0
Packer's Union Gardeners' Complete Manure	. ..	.....	2.31	2 47	.....	.. ...	6.60	6.0	.....	.....	10.87	10.0
Packer's Union Potato Manure	2.24	2.30	2.08	2.06	8.05	9.16	8.08	8.0	6.20	6.13	7.95	6.0
Packer's Union Universal Fertilizer	1.14	*1.20	1.32	.82	9.21	*8.62	8.18	8.0	5.40	*3.82	4.17	†4.0
Packer's Union Wheat, Oats and Clover Fertilizer	.....	.....	.....	.....	12.66	10.80	10.49	11.0	2.48	2.14	1.99	2.0
Quinnipiac Climax Phosphate	1.16	1.47	... ..	1.03	8.86	9.25	.....	8.0	2.64	2.58	.....	2.0
Quinnipiac Corn Manure	2.21	2.12	2.44	2.06	9.28	9.66	7.84	†8.0	2.39	1.75	1.90	1.50
Quinnipiac Market Garden Manure	.....	.....	3.19	3.30	.....	.....	8.55	8.0	.....	.....	6.69	7.0
Quinnipiac Mohawk Fertilizer	.. ...	.....	1.68	.82	.....	.....	7.52	7.0	.....	.....	1.37	1.0
Quinnipiac Phosphate	*2.25	2.64	.....	†2.50	*9.02	9.59	.....	9.0	*2.38	2.24	.....	2.0
Quinnipiac Potato Manure	*2.32	2.49	2.51	†2.50	*7.98	8.30	5.72	6.0	*4.60	5.50	5.79	5.0

* Average of two analyses.

† Guarantee changed.

COMPARISON OF GUARANTEES AND STATION SAMPLES FOR THREE YEARS—Continued.

Name of Fertilizer.	Nitrogen.				Available Phosphoric Acid.				Potash.			
	Found.			Guaranteed in 1901.	Found.			Guaranteed in 1901.	Found.			Guaranteed in 1901.
	1899.	1900.	1901.		1899.	1900.	1901.		1899.	1900.	1901.	
	%	%	%	%	%	%	%	%	%	%	%	%
Quinnipiac Potato Phosphate	*2.11	2.18	2.30	2.06	*8.58	10.24	8.18	8.0	*3.01	3.20	3.48	3.0
Quinnipiac Seeding Down Manure	1.24	1.26	1.49	†1.03	9.71	7.97	9.11	†8.0	2.39	1.97	2.51	2.0
Quinnipiac Special with 10% Potash	.....	.....	2.26	2.47	.....	.....	6.50	6.0	.....	.....	10.41	10.0
Read's Potato Manure	*2.34	2.36	2.23	2.47	*8.41	7.35	6.60	†6.0	*10.38	10.60	10.59	10.0
Read's High Grade Farmers' Friend	.....	.....	3.25	3.30	.....	.....	7.08	6.0	....	.....	9.55	10.0
Read's Practical Potato Special	1.03	1.08	1.32	.82	4.42	6.11	4.66	4.0	9.13	8.29	9.22	8.0
Read's Samson Fertilizer	1.75	1.86	.....	†2.06	6.62	7.09	.....	†8.0	4.52	4.61	.....	†3.0
Read's Standard Fertilizer	1.10	1.09	.....	.82	8.09	8.58	.....	8.0	4.40	4.23	....	4.0
Read's Sure Catch	..	.....	.....	....	6.12	6.61	....	†10.0	3.62	4.18	.....	†2.0
Read's Vegetable and Vine Fertilizer	1.75	2.08	2.15	†2.06	6.89	8.61	7.99	†8.0	8.96	5.85	6.92	†6.0
Standard A Brand	1.20	1.28	1.03	.82	8.60	7.97	7.56	7.0	1.18	1.58	1.46	1.0
Standard Bone and Potash	.....	.....	.....	.....	10.25	.....	.....	†10.0	2.39	.....	.....	†2.0
Standard Complete Manure	.....	3.34	.....	3.30	.....	8.30	.....	8.0	.....	7.15	.....	7.0
Standard Fertilizer	2.21	2.32	2.27	†2.06	10.09	8.88	8.07	8.0	2.22	2.69	1.85	†1.50
Standard Guano	1.52	1.23	1.47	†1.03	9.56	8.41	9.50	†8.0	3.28	2.33	2.51	†2.0
Standard Special for Potatoes	*2.13	2.20	.....	2.06	*8.40	9.48	.....	8.0	*3.02	3.14	.....	3.0
Williams and Clark's Americus Ammoniated Bone Superphosphate	2.34	2.58	2.42	†2.50	10.29	9.67	9.76	9.0	2.36	2.49	2.52	2.0
Williams and Clark's Americus Corn Phosphate	*2.29	2 20	2.40	2.06	*8.87	9.44	9.35	†8.0	*2.14	1.94	1.95	1.50
Williams and Clark's Americus Potato Manure	*2.09	2.10	*2.17	2.06	*8.84	8.78	*8.54	†8.0	*2.92	3.42	*3.29	3.0
Williams and Clark's Americus with 10% Potash	.....	.....	2.43	2.47	.....	.....	6.16	6.0	.....	.....	11.03	10.0
Williams and Clark's High Grade Special	....	.....	.....	3.30	.....	.....	.....	8.0	.....	.. ..	.....	7.0

Williams and Clark's Potato Phosphate	2.48	2.36	2.29	†2.50	7.63	6.14	6.21	6.0	5.14	5.84	5.68	5.0
Williams and Clark's Royal Bone Phosphate	1.16	1.10	1.42	1.03	9.20	9.42	10.48	†8.0	2.30	2.63	2.16	2.0
Bowker's Corn Phosphate	1.57	1.63	1.56	†1.50	7.88	8.32	9.37	†8.0	2.59	2.49	2.31	2.0
Bowker's Early Potato Manure	3.16	3.19	*2.80	3.0	7.38	7.80	*7.79	7.0	8.16	7.58	*7.86	7.0
Bowker's Farm and Garden Phosphate	1.66	1.66	1.47	1.50	10.19	9.74	8.71	†9.0	2.22	2.26	2.54	2.0
Bowker's Hill and Drill Phosphate	2.33	2.26	2.19	2.25	10.06	8.90	9.41	9.0	2.41	2.30	2.23	2.0
Bowker's Market Garden Fertilizer	2.74	.....	2.27	2.25	6.25	.....	7.48	6.0	10.69	.....	10.85	10.0
Bowker's Potash Bone	.86	.81	.99	.75	5.87	7.72	9.65	6.0	2.26	2.57	1.22	2.0
Bowker's Potash or Staple Phosphate	1.03	.84	.88	.75	9.62	8.82	7.94	8.0	3.15	3.28	5.38	3.0
Bowker's Potato and Vegetable Fertilizer	2.38	2.51	2.10	2.25	8.41	9.62	10.17	†9.0	4.12	4.58	4.60	4.0
Bowker's Potato and Vegetable Phosphate	1.59	1.66	1.53	1.50	9.25	10.48	8.98	†9.0	2.35	2.34	2.06	2.0
Bowker's 6% Potato Fertilizer	.99	.92	.90	.75	8.36	9.06	8.31	†6.0	6.37	6.18	6.59	6.0
Bowker's Square Brand Bone and Potash	2.07	1.85	1.53	1.50	5.98	6.65	6.75	6.0	2.41	2.51	2.28	2.0
Bowker's Sure Crop Phosphate	1.02	.96	.90	.75	9.75	9.69	8.90	†9.0	2.30	2.05	1.96	†2.0
Bowker's 10% Manure	.97	.82	.75	.75	6.76	6.98	7.55	†5.0	10.46	10.44	9.67	10.0
Gloucester Fish and Potash	.88	.84	.88	.75	9.73	10.29	6.20	6.0	1.49	1.35	2.20	1.0
Stockbridge Corn and Grain Manure	3.21	3.02	2.83	3.0	9.19	9.89	7.82	†7.0	7.28	7.07	7.18	†7.0
Stockbridge Potato and Vegetable Manure	3.28	*3.09	2.87	†3.0	6.82	*7.51	7.40	6.0	11.99	*10.08	10.50	10.0
Stockbridge Seeding Down Manure	2.74	2.05	2.27	†2.25	6.75	8.61	7.72	6.0	10.60	10.22	10.04	10.0
E. Frank Coe's Celebrated Special Potato Fertilizer	1.94	.....	1.82	1.65	9.18	.....	8.77	8.0	4.21	....	4.07	4.0
E. Frank Coe's Columbian Corn Fertilizer	1.50	1.19	1.42	†1.20	9.85	9.06	9.52	8.50	3.03	2.55	2.99	2.50
E. Frank Coe's Columbian Phosphate	.....	.....	*1.59	1.20	.....	.....	*8.92	8.50	.....	.....	*3.06	2.50
E. Frank Coe's Columbian Potato Fertilizer	1.33	1.42	1.26	1.20	8.95	9.24	8.76	8.50	2.91	2.81	2.43	2.50
E. Frank Coe's Excelsior Potato Fertilizer	2.69	*2.81	2.46	†2.40	8.25	*7.72	8.12	†7.0	8.09	*7 57	8.61	8.0
E. Frank Coe's Famous Grass and Grain Fertilizer	1.04	1.08	1.02	.80	9.96	9.96	8.59	8.50	2.28	2.06	1.87	†1.50
E. Frank Coe's Ground Bone and Potash	.....	.....	1.66	2.00	.....	.....	5.14	.....	.....	.....	3.16	2.0
E. Frank Coe's High Grade Ammoniated Bone Superphosphate	2.14	1.97	1.71	1.85	9.47	8.68	9.49	9.0	2.66	2.72	2.51	2.25
E. Frank Coe's High Grade Potato Fertilizer	2.74	2.46	2.31	2.10	8.39	7.99	8.37	†7.50	6.35	6.70	6.07	†6.0
E. Frank Coe's New Englander Corn Fertilizer	.....	.96	1.20	.80	.....	8.44	8.44	7.50	.....	3.18	3.20	3.0
E. Frank Coe's New Englander Potato Fertilizer	1.07	1.03	1.21	.80	8.40	9.07	8.34	†7.50	3.38	3.61	3.26	3.0
E. Frank Coe's Prize Brand Grain and Grass Fertilizer	.....	.....	.....	....	10.65	10.36	9.99	10.50	2.26	2.26	2.06	2.0
E. Frank Coe's Original Ammoniated Dissolved Bone Phosphate	.....	....	1.31	1.25	.....	.....	8.34	9.0	.....	.....	2.75	2.25

* Average of two analyses.

† Guarantee changed.

COMPARISON OF GUARANTEES AND STATION SAMPLES FOR THREE YEARS—Concluded.

Name of Fertilizer.	Nitrogen.				Available Phosphoric Acid.				Potash.			
	Found.			Guaranteed in 1901.	Found.			Guaranteed in 1901.	Found.			Guaranteed in 1901.
	1899.	1900.	1901.		1899.	1900.	1901.		1899.	1900.	1901.	
	%	%	%	%	%	%	%	%	%	%	%	%
E. Frank Coe's Red Brand Excelsior Guano	.....	3.43	3.06	3.40	.....	8.56	9.03	9.0	6.31	.....	7.24	6.0
E. Frank Coe's Standard Grade Ammoniated Bone Superphosphate	1.49	1.37	1.49	†1.50	9.91	9.89	9.41	†8.50	2.45	2.66	2.44	†2.0
Elwell's Eureka Fetilizer	.....	.....	1.97	2.0	.....	.....	7.59	7.0	.....	.....	6.83	7.0
Elwell's Excelsior Potato Fertilizer	.....	2.66	2.62	†2.85	.....	6.13	6.63	5.50	.....	10.68	9.89	10.0
Lister's Animal Bone and Potash, No. 2	.....	.....	.....	.....	.....	.....	9.73	10.0	.....	.....	2.53	2.0
Lister's High Grade Special for Spring Crops	.....	1.88	1.59	1.65	...	8.46	8.74	8.0	.....	10.02	10.83	10.0
Lister's Seeding Down Fertilizer	.94	.81	1.10	†.83	10.43	12.14	7.70	†7.0	1.49	1.05	1.92	†1.0
Lister's Special Corn and Potato Fertilizer	1.73	*1.77	1.65	1.65	7.92	*8.95	8.50	8.0	3.51	*2.98	3.33	3.0
Lister's Success Fertilizer	1.51	1.44	1.26	1.24	9.51	9.89	9.62	†9.0	2.24	8.10	2.39	2.0
Lister's U. S. Superphosphate	1.49	1.42	1.66	†1.03	7.02	7.75	9.38	†8.0	2.77	2.37	2.36	2.0
Swift's Lowell Animal Brand	2.62	2.64	2.86	2.46	9.25	9.64	8.18	9.00	4.59	4.13	3.98	4.0
Swift's Lowell Bone Fertilizer	1.76	1.75	1.98	1.64	7.54	8.07	7.29	8 0	4.13	3.35	3.17	3.0
Swift's Lowell Dissolved Bone and Potash	1.86	1.88	1.87	1.64	8.83	9.41	9.68	9.0	2.35	2.39	2.20	2.0
Swift's Lowell Ground Bone	2.08	2.04	1.72	2.47	.....	.....	15.18	5.0	.....	.....	.....	.....
Swift's Lowell Potato Manure	.....	1.84	1.95	1.64	.....	6.99	7.61	7.0	.....	4.01	4.56	4.0
Swift's Lowell Potato Phosphate	2.56	2.54	2.81	2.47	7 80	8.27	7.90	8.0	6.51	7.03	6.48	6.0
New England Corn Phosphate	.....	1.70	1.91	1.64	.....	8.79	8.10	8.0	.....	3.31	3.61	3.0
New England High Grade Truck Fertilizer	.....	.....	3.39	3.30	.....	.....	6.08	6.0	.....	.....	10.32	10.0
New England Potato Fertilizer	.....	*1.82	1.77	1.64	.....	*7.10	8.09	7.0	.....	*4.24	4.52	4.0
Chittenden's Ammoniated Bone Phosphate	2.04	2.12	1.88	†1.65	9.71	9.81	10.17	†8.0	2.35	2.25	2.84	2.0
Chittenden's Complete Fertilizer	3.52	3.35	3.47	†3.00	8.14	7.72	8.13	8.0	6.27	6.14	6.79	6.0

Chittenden's Market Garden Fertilizer	2.56	2.57	*2.55	†2.45	7.73	6.38	7.78	†6.0	7.00	5.68	5.81	
A. A. Brand Fertilizer	4.21	...	4.54	4.53	8.15	.....	8.92	7.0	9.46	....	8.84	
P. and P. Grain Grower	.....	.....	.....	.82	.....	.....	.....	7.0	.....	.....	....	
P. and P. Potato Fertilizer	2.26	1.97	1.75	1.64	7.00	7.94	6.36	6.0	7.03	5.66	6.50	†6.0
Plymouth Rock Brand Fertilizer	2.67	2.90	2.71	2.47	9.94	9.30	8.53	8.0	5.02	5.11	5.00	4.0
Special Potato Fertilizer	3.27	3.49	3.36	3.29	8.57	9.65	8.47	8.0	8.30	7.47	7.55	7.0
Star Brand Superphosphate	1.78	1.95	.....	1.64	7.80	8.24	.....	7.0	3.26	3.27	.....	2.5
E. J. Philbrick's High Grade Fertilizer	2.04	1.63	1.87	2.00	6.24	7.62	7.43	7.0	6.72	6.34	4.90	5.0
Portland Rendering Co.'s Bone Tankage	4.54	4.84	4.57	†4.27	6.14	9.64	9.32	†7.34	.....	.....	.....	.....
Provincial Chemical Co.'s Special Potato Phosphate	.92	3.21	3.31	†3.25	9.50	9.67	8.44	†8.0	6.43	4.76	3.41	†6.0
Essex A1 Superphosphate	.....	.....	1.14	1.00	....		6.33	7.0	.....	....	2.02	2.0
Essex Complete Manure for Corn, Grain and Grass	.....	3.84	.....	†3.30	.....	8.47	....	7.0	.....	10.11	.....	†5.0
Essex Complete Manure for Potatoes, Roots and Vegetables	.....	3.96	4.20	3.70	.....	8.15	8.81	7.0	.....	8.69	9.15	8.5
Essex Corn Fertilizer	.....	2.13	2.08	2.00	.....	8.77	8.33	9.0	.....	3.41	3.05	3.0
Essex Market Garden and Potato Manure	2.00	2.03	2.39	2.00	11.36	8.96	8.10	†8.0	6.29	6.27	6.09	5.0
Essex Special Fertilizer for Aroostook County	.....	...	2.50	2.50	.....	.....	7.45	7.0	.....	.....	6.03	5.0
Essex XXX Fish and Potash	2.54	2.76	2.47	2 10	10.66	9.56	8.13	9.0	2.46	2.82	2.76	2.25
Maine State Grange Chemicals	2.53	2.84	2.55	2.50	8.69	9.35	9.31	8.0	4.31	5.44	4.45	4.0
Maine State Grange Potato Manure	1.02	1.68	1.68	1.50	10.84	10.96	10.08	9.0	12.47	11.16	12.69	12.0
Maine State Grange Seeding Down Fertilizer	.....	1.60	1.73	1.50	.....	6.86	8.04	7.0	.....	5.47	5.27	5.5
Aroostook Potato Manure	.....	.....	1.36	1.25	.....	.....	7.31	5.0	.....	.....	4.01	2.5
Dirigo Fertilizer	1.46	1.58	1.19	†1.50	5.29	6.12	7.76	†7.0	5.53	4.23	2.73	†3.0
Sagadahoc Special Potato Fertilizer	*2.27	*1.44	2.11	†2.50	*8.60	*9.32	5.87	†6.0	*8.66	9.69	10.93	7 0
Sagadahoc Superphosphate	2.03	*1.86	2.09	†2.00	8.86	8.78	8.37	†7.0	6.12	*4.41	3.86	†3.0
Yankee Fertilizer	1.06	1.02	1.15	†.50	6.11	5.20	5.28	†3.0	4.39	4.90	1.26	†.0
Watson's Improved High Grade Potato Manure	2.55	2.72	3.17	†3.00	6.05	5.84	6.36	6.0	5 00	4.97	6.02	5.0

* Average of two analyses.

† Guarantee changed.

COMPARISON OF GUARANTEES AND STATION SAMPLES FOR THREE YEARS.

It is important for the purchaser of fertilizers to know how the goods have compared with the guarantee, not merely for one year but for several years. Formerly we have printed a table comparing the analysis of the manufacturers' and Station samples for the year with the guarantee. In the table on pages 170 to 175 there is given a comparison of the analyses of the samples collected by the Station for the years 1899, 1900 and 1901 with the guarantee of the manufacturers. When the guarantee has been changed in 1898 from that of the previous years the fact is indicated by a †, and where more than one analysis of the same brand was made in 1898, this is indicated by a *.

One of the claims which fertilizer manufacturers are making for the superiority of their goods over "home mixed fertilizers" is that the former are "manufactured." This should mean, if it means anything, that the goods are more evenly mixed and therefore more uniform. In some instances in which two or more samples of the same brand have been taken and analyzed, they have been found to differ from each other quite materially. The samples were taken with a great deal of care by experienced men from a large number of packages. It would not seem difficult to make "home mixed fertilizers" which should run as uniform as some of the brands here reported upon.

In studying the table of comparison of guarantees of the Station samples for three years, it will be found that many goods run quite uniform year after year. This is particularly true as regards phosphoric acid and is readily understood when it is remembered that the "superphosphate" is the starting point and that the materials furnishing the nitrogen and potash are added to this. The potash and nitrogen are the more expensive substances in fertilizers and greater variations in composition are found in these constituents.

NEWSPAPER BULLETINS PUBLISHED IN 1901.

CHAS. D. WOODS.

Whenever there is matter of importance which we wish to bring promptly to the attention of the people of the State, we make as clear and concise a statement as possible in the style and type of a newspaper column and mail it as a "Special Newspaper Bulletin" to all the press of the Station exchange mailing list. These Newspaper Bulletins are quite generally printed by the papers and the Station is under obligations to the press for this opportunity of specially and promptly being put in touch with the people.

During the year the Station has issued several special newspaper bulletins on miscellaneous subjects and 12 monthly meteorological bulletins. The results of the meteorological observations thus reported are summarized beyond. The matter of three of the newspaper bulletins has not appeared in any of the regular bulletins of the Station and is therefore here reprinted as a matter of permanent record.

THE COLORADO POTATO BEETLE.

Effects of poisons with and without Bordeaux mixture on badly infested fields.

In a series of experiments in 1901 it was found that three applications of Paris green at the rate of one-half pound to the acre is sufficient to keep the vines free from the Colorado potato beetle, provided the sprayings are made at such times as to have the poison on all the foliage when the bugs first hatch.

Every year many potato growers wait until the vines are well covered with the bugs before beginning to fight them, and then the Station is in receipt of letters of complaint against the quality of the poisons, and requests for analysis. As this condition of

eaten vines covered with bugs is ever recurring, it was decided to make a test of the effect of different amounts of poison upon the bugs on a badly infested field. Since it was thought the presence of the copper salts in Bordeaux mixture might affect the results, the poisons were used both with and without Bordeaux mixture. As no practical remedy other than arsenic has thus far been found for the potato beetle, arsenite of copper (Paris green) and arsenate of lead were used.

The field selected contained 15 to 20 acres. The bugs were very numerous and some of the vines were badly eaten. The poisons were applied with a mechanical 4-rowed sprayer fitted with a powerful pump and double Vermorel nozzles. A barrel of each mixture was so applied as to cover a little more than one acre. The Paris green was applied at the rate of ½, 1, 2 and 3 pounds per barrel of 50 gallons, both with and without Bordeaux mixture. The arsenate of lead was applied at the rate of 1, 2 and 3 pounds per barrel, both with and without Bordeaux mixture.

Where Paris green was used with the Bordeaux mixture, lime was added at the rate of 3 pounds to the barrel in order to prevent the burning of the foliage. While arsenate of lead does not burn the foliage, the lime was applied with it in order that the methods of application of the poisons should be comparable.

Because the center of the field was more badly infested than either end, the spraying was begun with both Paris green and arsenate of lead from the center. Plot "A" was at the extreme north of the field and plot "O" was at the extreme south. In reporting below these are arranged in accordance with the kinds and amounts of poisons used rather than in the arrangement in the field.

The poisons were applied on the morning of Tuesday, July 9. Late in the afternoon of July 10th, there was a heavy shower. The observations were made early Friday morning, July 12th. The arrangement and treatment of plots follow:

(F). ½ lb. Paris green; 3 lbs. lime. A good many bugs still left on some plants. Some badly eaten plants cleaned from bugs; other still badly infested.

(G). 1 lb. Paris green; 3 lbs. lime. Some bugs still left. An occasional plant badly infested. Cleaner than F.

(H). 2 lbs. Paris green; 3 lbs. lime. No cleaner than G.

(I). 3 lbs. Paris green; 3 lbs. lime. Quite free from bugs. Only a few on occasional plants.

(K). ½ lb. Paris green; Bordeaux mixture. Very few bugs.

(L). 1 lb. Paris green. Bordeaux mixture. Much the same as K.

(M). 2 lbs. Paris green; Bordeaux mixture. Not quite as clean as L and K.

(N). 3 lbs. Paris green; Bordeaux mixture. Not as clean as M, L, or K.

(E). (This plot lies next to F in the field). 1 lb. arsenate of lead; 3 lbs. lime. Quite clean.

(D). 2 lbs. arsenate of lead; 3 lbs. lime. Rather better than E.

(C). 3 lbs. arsenate of lead; 3 lbs. lime. Not as clean as D or E.

(B). 1 lb. arsenate of lead; Bordeaux mixture. Better than C. About the same as E.

(A). 2 lbs. arsenate of lead; Bordeaux mixture. Very clean; about the same as D.

(O). (In the field, this plot lies next to N). 3 lbs. arsenate of lead; Bordeaux mixture. Very clean; much cleaner than K, L, M or N.

From the above it is seen that Paris green with Bordeaux mixture was more effective than Paris green without the Bordeaux. It was expected that the result would be otherwise, as in other cases the bugs seemed to dislike and avoid the copper salts as far as possible. It is probable that Wednesday's shower washed off the Paris green when applied with white wash (lime) but did not affect it as much when it was applied with Bordeaux mixture.

The arsenate of lead seemed to kill equally as well whether applied with lime or with the Bordeaux mixture. This can probably be explained by the fact that arsenate of lead when once dried is with difficulty washed from the foliage. The arsenate of lead killed better than did the Paris green. This may be explained by the washing off by the shower of the Paris green both with and without Bordeaux mixture.

One-half pound of Paris green or 1 pound of arsenate of lead applied with the Bordeaux mixture was effective in cleaning the

badly infested field from the great majority of the bugs. When plants are making as rapid growth as were these potatoes (each stem growing about an inch a day), it is impossible with one application to entirely free them from bugs, because there will always be new leaves for the bugs to crawl onto and feed upon.

In the opinion of the writer, in order to kill potato bugs with poisons, there are two important things to be observed. First, the poison must be as evenly distributed as possible over the entire plant; and in the case of infested fields, the first application must be followed in one or two days by a second application in order to kill the bugs on the new foliage.

Feeding Stuffs Inspection Law.

Another instance of low grade cotton seed meal excluded from Maine markets.

The best laws are those which operate so quietly that the public is likely to doubt their necessity or even to forget their existence. It is only occasionally that an open and conspicuous violation of our statutes calls for their full and prompt enforcement and satisfactorily demonstrates their effectiveness.

Since the enactment of the law regulating the sale of concentrated commercial feeding stuffs, it has occasionally, but decreasingly, been said that the law is of no value. In the publications of the Station the opposite of this position has been taken, and evidence has from time to time been submitted to prove the value of the law and the wisdom of the legislature that enacted it. A recent instance of its working, in ways not generally appreciated, is of interest and importance since it indicates also a desire on the part of the large handlers of feeding stuffs to conform to the law and to give their customers high grade goods.

It has been many months since the Station has received a sample of low grade cottonseed meal, either from correspondents or through its inspectors; but a week ago a sample of bright cottonseed meal of good color and mechanical condition was received from one of the largest jobbing houses in the State with the request that it be analyzed. Accordingly the protein and fat were determined and the following letter written:

"The sample of cottonseed meal which you sent us carries 22.44 per cent. protein and 6.48 per cent. fat. There is apparently some coloring matter added to conceal the cotton hulls which are ground with the sample. After extracting with ether, which we do in estimating the fat, the meal instead of being yellow, like the original sample, is nearly black.

"This is the poorest cottonseed that we have seen in this State for a good many months. I trust that you are not intending to offer it for sale at any price. I should be pleased to know the history of the sample. There is no charge for the analysis."

The reply received was as follows:

"Yours of September 18th received. The cottonseed meal was sent to us by a New York party who wished us to handle the product of the mill. We requested, for the first thing we did, to send us the analysis of it which they failed to do, but they still kept trying to make arrangements with us to handle their meal. We at last requested them to send us a large sample, which we immediately sent you for analysis and now that we have found it so poor, we certainly shall not handle any of it, and shall make sure that none of our competitors do.

"We do not handle any meal that runs less than 43 per cent. protein, and we intend to and try to buy all the meal that we can that contains a higher per cent."

The law has resulted in the education of the dealer so that he has knowledge of the feeding value of the goods he handles. While as a whole, feed dealers have always been anxious to give full value in the goods they sell, the feeding stuffs law enables them to know the quality of the materials they handle, not only from their appearance but from their chemical composition.

As soon as the winter stock of feeding stuffs are in the market, the Station representatives will draw samples for analysis. The results cannot be published and ready for distribution until January or February. In the meantime if the feeders desire to know the quality of the goods they are using, or dealers what they are selling, a two ounce sample sent to the Station (preferably in tin or glass) will be promptly analyzed and the results reported to the correspondent without cost to the sender. Such co-operation will materially add to the effectiveness of the law.

The Chinch Bug.

Damage in western Maine. Description and remedies.

The chinch bug is a blackish insect, from one-eighth to one-sixth of an inch long, and about one-twentieth of an inch broad. When disturbed it emits a characteristic "stinkbug" odor. Two forms may be distinguished according to the length of the wings, which are white and thin, almost like tissue paper. The long winged form has wings covering the whole of the abdomen or back and colored at the center of each outer edge by a black diamond shaped spot. The short winged form has wings reaching only about half the length of the abdomen and looking like a short, whitish letter X laid on the middle of the back. Both of these forms hide during the winter in favorable places. and during warm weather in spring, probably the latter part of May or early June, make their way to places suitable for laying their eggs. These are whitish in color, about the size of the eye of a fine needle, and are laid among the roots and bases of the stems of grass and grain. Each female bug may lay during two or three weeks from 300 to 500 eggs. These hatch out in about two weeks and the young reach maturity about four weeks later, working in the meantime about the roots of the grass. The older larvae and the adults work usually on the stems of the plants, sucking the sap and thus causing the plants to wither and finally to die.

Complaints received at the Experiment Station during the summer indicated that the chinch bugs were doing considerable damage to the grass crop in western Maine. An examination by the assistant zoologist of the station into the conditions existing in the town of Fryeburg during the latter part of September showed that the chief injury was to timothy and hungarian grass, although corn and oats were in some instances attacked, as was also witch grass and barn grass. Timothy was completely killed over areas varying in size from a few square yards to others of several acres. In some instances clover and witch grass had grown up in these spots. Barn grass growing among corn was completely killed and witch grass was killed to the ground, but grew up again as the bugs passed outward.

Although the damage for this year had ceased, the bugs were easily found; in one case clustering in large numbers under the dead leaves, stems and other debris among the clover immediately bordering a spot on which the timothy had been killed; in another case crowding among and about the clumps of beard grass and sedge grass bordering a strip of hungarian grass. In such places as these and under dead grass and weeds about fence corners and fields; under manure spread in the fall and not plowed under; in masses of dead leaves, bark or brush heaps, and rubbish of all sorts, the bugs pass the late fall and winter months, lying apparently dead during cold weather, but quickly coming into activity during the warm days of late spring.

As the amount of injury next year will depend largely on the number of bugs which winter over safely, it is important that pains be taken to destroy as many as possible before the ground is covered with snow. The following methods are probably the best for the State of Maine.

1st. Burning. Where there is considerable clover mixed with the hungarian or timothy, the bugs are very likely to winter over beneath the clover which borders for a few feet or yards immediately upon the spot where they have stopped injuring the grass. If such a strip be mowed closely by hand and allowed to dry for a few days it may be burned over and quantities of the bugs will be killed. If this burning be done after the ground has frozen, little, if any, injury will be done to the crop. All rubbish such as dried grass and weeds along the edges of fields, brush heaps, dead leaves, bark and chips, clumps of wild grasses, sedge grasses etc., in near by fields should be burned as completely as possible.

2d. Spraying. Chinch bugs are quickly killed by kerosene or kerosene emulsion, but it is essential that it be thoroughly applied. The bugs are so protected by the clover and grass that it is almost impossible to reach them by ordinary spraying. Sprinkling freely over the infested spots will usually be effectual but will probably kill the grass also. Clumps of sedge or wild grass in which careful examination shows the bugs to be abundant might be sprinkled thoroughly with kerosene and then burned, thus killing bugs which had crowded deep down among

the bases of the plants, where the flames alone might not reach them.

3d. Plowing. Where bugs are found in considerable numbers at the edges of spots which they have eaten over, they may be destroyed by plowing under the strip in which they are hiding. Deep plowing, however, is necessary, followed by dragging and rolling in order to completely cover under all vegetation and close up all holes or passages through which the bugs might make their way to the surface.

If used promptly and thoroughly, these methods are also applicable when the bugs are found to be working during early summer and are all the more effective because the bugs do not scatter over the whole field but stay together in comparatively small areas or strips, and if they are promptly killed over such patches further injury for the season will be very much lessened.

ACKNOWLEDGMENTS.

Acknowledgment is hereby made for the following gifts to the Station during 1901:

Seeds, plants, cuttings and samples of food materials.—United States Department of Agriculture.

Cuttings and Seeds.—Cornell University, Ithaca, N. Y.

Nitrate of soda.—Propaganda for the Use of Nitrate of Soda, New York City.

Sulphate, Carbonate and Muriate of Potash and Kainit.—German Kali Works, New York City.

Disparene, Bodo, Dry Bordeaux Mixture and Creosote Emulsion.—Bowker Chemical Company, Boston.

Dog Bane, dry for an insecticide.—Comisión de Parasitología Agrícola, City of Mexico, Mexico.

Aroostook Power Sprayer for Potatoes.—Field Force Pump Company, Lockport, N. Y.

Orchard Lamp for moths.—A. F. Severance, Nobleboro, Maine.

Lincoln Dip and Lincoln Disenfectant.—Pasteur Vaccine Company, Chicago.

Cyphers Anti Fly Pest—Cyphers Incubator Company, New York City.

Alderney Butter Color—Heller and Merz Co., New York City.

Sugar Feed—Conover & Co., Minneapolis, Minn.

Peep O'Day Brooder—E. F. Hodgson, Dover, Mass.

Brooder—Cyphers Incubator Company, New York City.

The Station receives in exchange for its bulletins and reports, the official agricultural publications of American Experiment Stations and State and National Departments of Agriculture, Horticulture and Dairying and those of Australia, Brazil, Canada, Chili and other foreign countries. Many private institutions, both at home and abroad, which issue publications bearing upon agricultural subjects, kindly send them to the Station Library.

In addition to the above, the following newspapers and other publications are kindly donated to the Station by the publishers:

Agricultural Epitomist, Indianapolis, Ind.
Agricultural Experiments, Minneapolis, Minn.
Agricultural Advertising, Chicago, Ill.
Agricultural Gazette, Sidney, New South Wales.
Agricultural Journal, Maritzburg, Natal.
American Cultivator, Boston, Mass.
American Fertilizer, Philadelphia, Pa.
American Gardening, New York City.
American Grange Bulletin, Cincinnati, O.
American Grocer, New York City.
American Miller, Chicago, Ill.
Baltimore Weekly Sun, Baltimore, Md.
Bangor Weekly Commercial, Bangor, Me.
Beet Sugar Gazette, Chicago, Ill.
Breeder's Journal, Himrods, N. Y.
Boletem de Agricultura, San Paulo, Brazil.
Canadian Horticulturist, Grimsby, Ont.
Chronique Agricole, Lausanne, Switzerland.
Country Gentleman, Albany, New York.
Dairy World, Chicago, Ill.
Detroit Free Press, Detroit, Mich.
Dietetic and Hygienic Gazette, New York City.
Elgin Dairy Report, Elgin, Ill.
Farmers Advocate, London, Ont.
Farmer's Guide, Huntington, Ind.
Farmer's Tribune, Des Moines, Iowa.
Farm News, Springfield, O.
Farm Home, Springfield, Ill.
Farm Journal, Philadelphia, Pa.
Farm-Poultry, Boston, Mass.
Farmer's Review, Chicago, Ill.
Farmer's Voice, Chicago, Ill.
Florist's Exchange, New York City.
Florist's Review, Chicago, Ill.
Forester, Princeton, N. J.
Flour and Feed, Waukegan, Ill.
Garden and Farm, Chicago, Ill.
Golden Egg, St. Louis, Mo.
Green's Fruit Grower, Rochester, N. Y.

Hoard's Dairyman, Fort Atkinson, Wis.
Herd Register, Peterborough, N. H.
Holstein Friesian Register, Brattleboro, Vt.
Homestead, Des Moines, Iowa.
Horticultural Visitor, Kinmundy, Ill.
Inland Poultry Journal, Indianapolis, Ind.
Jersey Bulletin, Indianapolis, Ind.
Journal of the Department of Agriculture, Perth, Western Australia.
Leader and Farm Journal, Fort Fairfield, Me.
Live Stock Journal, Chicago, Ill.
La Grele Station Viticole de Villefranche. (Rhone) France.
La Laiterie Belge, Enghein, Belgium.
Louisiana Planter, New Orleans, La.
Lewiston Weekly Journal, Lewiston, Maine.
Maine Farmer, Augusta, Me.
Massachusetts Ploughman, Boston, Mass.
Milk News, Chicago, Ill.
Mirror and Farmer, Manchester, N. H.
Modern Miller, St. Louis, Mo.
National Farmer and Stock Grower, National Stock Yards, Ill.
National Stockman & Farmer, Pittsburg, Pa.
New England Farmer, Boston, Mass.
New England Homestead, Springfield, Mass.
New York Farmer, Port Jervis, N. Y.
New York Produce Review, New York City.
North American Horticulturist, Monroe, Mich.
Northwestern Miller, Minneapolis, Minn.
Ohio Farmer, Cleveland, O.
Operative Miller, Chicago, Ill.
Oregon Agriculturist, Portland, Oregon.
Park & Cemetery, Chicago, Ill.
Practical Farmer, Philadelphia, Pa.
Practical Fruit Grower, Springfield, Mo.
Progressive Farmer, Newport, Vt.
Public Ledger, Philadelphia, Pa.
Reliable Poultry Journal, Quincy, Ill.
Ruralist, Gluckheim, Md.
Rural Californian, Los Angeles, Cal.

Rural New Yorker, New York City.
Rural Topics, Morgan City, La.
Southern Farm Magazine, Baltimore, Md.
Southern Farmer, New Orleans, La.
Southern Planter, Richmond, Va.
Strawberry Specialist, Kittrell, N. C.
Sugar Beet, Philadelphia, Pa.
Turf, Farm & Home, Waterville, Me.
Up-to-Date, Indianapolis, Ind.
Vick's Magazine, Rochester, N. Y.
Weekly Union, Manchester, N. H.
Western Fruit Grower, St. Joseph, Mo.
West Virginia Farm Review, Charleston, West Va.
The World, Vancouver, B. C.

METEOROLOGICAL OBSERVATIONS.

Lat. 44° 54′ 2″ N. Lon. 68° 40′ 11″ W. Elevation 150 feet.

The instruments used at this Station are the same as those used in preceding years, and include: Wet and dry bulb thermometers; maximum and minimum thermometers; thermograph; rain-gauge; self-recording anemometer, vane, and barometer. The observations at Orono now form an almost unbroken record of thirty-three years.

The winter of 1900-1 was remarkable for the early snow that fell on unfrozen ground and later accumulated to an unusual extent. The total fall, however, was only about five-sixths of the average, and the large amount on the ground at one time was due to the lack of the usual winter thaws. The absence of the frost in the ground not only assisted in the rapid disappearance of the snow in the spring, but allowed the water from the melting snow and ice to enter the ground instead of escaping into the streams. The spring rains were excessive, and had the ground been in its usual condition the damage from floods, though serious in some localities, would have been much greater.

The following notes are intended to apply to this particular locality. The year has been characterized by the unusual distribution of rain and snow. The average precipitation for April at this Station, as shown by thirty-three years' observation, is 2.9 inches, lower than that for any other month of the year. The fall on April last was nearly double this amount, 5.12 inches, the largest thus far recorded at Orono for this month. Reference to the table on page 191 shows that these conditions were general through a large part of the State. During May, June and July the aggregate fall was four inches below the normal, and crops in some sections suffered severely. The usual heavy rains of November were lacking, and the deep snow that fell on November 14 found but little water in the ground and many low wells, conditions which were relieved by the thaw and rains of December 14 and 15. The total precipitation for December, (rain and melted snow) was 7.94 inches, double the usual amount. Extreme temperatures were noted in July, the thermometer on July 16 rising to 100°, dropping to 40° on the morning of July 25, a range of 60° in nine days.

METEOROLOGICAL SUMMARY FOR 1901.

Observations Made at the Maine Experiment Station.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean.	Total.
Highest barometer	30.43	29.89	30.31	30.30	30.12	30.07	30.06	30.15	30.27	30.42	30.20	30.35	30 22	.....
Lowest barometer	28.77	29.02	29.13	29.47	29.37	29.52	29.55	29.61	29.46	29.12	28.91	29.08	29.25	.....
Mean barometer	29.81	29.44	29.71	29.90	29.73	29.76	29.76	29.88	29.85	29.87	29.71	29.83	29.17	... .
Highest temperature	42°.0	40°.0	49°.0	76°.0	85°.0	91°.0	100°.0	86°.0	89°.0	71°.0	58°.0	55°.0	.....	. ....
Lowest temperature.	−20°.0	−18°.0	−13°.0	25°.0	32°.0	38°.0	40°.0	43°.0	28°.0	20°.0	−8°.0	−17°.0	.....	.....
Mean temperature	15°.03	14°.20	27°.74	44°.73	53°.90	63°.80	68°.60	66°.65	59°.50	47°.64	29°.10	23°.29	42.81	.....
Mean temperature for 33 years	16°.01	19°.13	27°.54	40°.54	52°.34	62°.09	67°.10	65°.13	57°.17	46°.05	34°.17	20°.73	42.33	.....
Total precipitation in inches	4.33	1.95	5.46	5.12	2.07	1.79	2.75	3.76	4.22	4.12	2.54	7.94	....	46.05
Mean precipitation for 33 years	4.36	4.07	4.29	2.90	3.58	3.55	3.31	3.57	3.39	4.07	4.37	3.84	.....	45.30
No. of days with precip. of .01 in. or more	12	5	11	9	13	9	11	8	8	8	9	12	.....	115
Snow fall in inches	25.5	19.5	11.7	... .	.....	.....	.... ..	.....	.....	trace	19.8	21.5	.....	98.0
Average snow fall for 33 years	23.3	21.6	16.9	5.6	.....	.....	.....	.....	.....	.9	8.2	16.9	....	93.4
Number of clear days	10	12	12	10	7	12	11	13	13	11	7	11	... ...	129
Number of fair days.	6	6	1	0	8	7	5	6	7	10	6	4	.....	66
Number of cloudy days	15	10	18	20	16	11	15	12	10	10	17	16	.....	160
Total movement of wind in miles	5767	7356	6214	5936	6253	4868	4440	4836	5315	5483	5005	6007	... .	..... .

Monthly and Annual Precipitation (as rain) for the Year 1901.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Bar Harbor	4.83	1.63	10.30	5.81	2.74	3.23	1.63	3.00	3.28	3.45	3.50	9.78	53.18
Belfast	4.51	2.16	7.80	6.49	2.09	.88	3.10	3.64	2.50	3.53	3.11	9.74	49.55
Bemis	3.60	1.20	5.90	7.14	.....	1.66	5.46	2.28	1.87	2.75	3.70	2.20	37.76
Carmel	6.67	1.90	3.75	4.92	2.95	1.95	3.00	2.91	3.58	3.56	2.40	.....	37.59
Cornish	3.03	1.26	5.70	11.52	8.40	1.79	6.25	9.00	3.06	3.47	2.00	7.52	63.00
Eastport	4.80	1.65	4.88	5.58	3.29	5.45	.91	2.48	2.92	1.72	1.91	6.02	41.61
Fairfield	2.74	1.95	5.22	3.96	2.35	1.64	2.99	3.39	3.79	2.77	2.19	7.98	40.97
Farmington	3.27	1.04	4.54	6.88	3.95	3.47	4.22	3.45	2.25	3.03	2.10	8.97	47.17
Flagstaff	2.20	1.50	2.75	7.83	2.34	4.58	5.01	4.95	1.65	2.40	2.20	4.88	42.29
Gardiner	3.78	1.76	6.25	6.43	3.92	1.36	4.26	5.54	2.08	4.18	2.41	9.43	51.30
Kineo	2.65	1.80	1.45	4.85	.75	6.55	1.95	2.55	.94	2 26	2.70	7.40	35 85
Lewiston	3.19	1.15	5.14	8.16	5.77	1.12	4.25	4.75	1.75	3.33	2.20	7.59	48.40
Mayfield	2.60	1.20	5.55	6.33	2.26	2.94	5.40	5.25	2.63	3.43	2.44	8.63	48.64
North Bridgton	...	...	1.70	4.80	7.60	7.56	3.91	5.13	5.46	2.55	3.24	2.14	5.75	49.84
Orono	4.33	1.95	5.46	5.12	2.07	1.79	2.75	3.76	4.22	4.12	2.54	7.94	46.04
Portland	3.34	1.68	6.43	7.47	7.17	.93	4.21	3.26	2.18	3.12	1.59	7.14	48.82
Rumford Falls	2.77	.74	4.05	7.91	6.54	3.84	4.91	3.47	2.59	3.48	1.76	5.53	47.59

With the exception of readings from the Orono station, the above table is compiled from the monthly bulletins of the U. S. Weather Bureau.

REPORT OF THE TREASURER.

Maine Agricultural Experiment Station in account with the United States appropriation, 1900-1901.

DR.

To receipts from the Treasurer of the United States as per appropriation for the fiscal year ending June 30, 1901, as per act of Congress approved March 2, 1887		$15,000 00

CR.

By salaries:		
(a) Director and administration officers	$2,451 24	
(b) Scientific staff	4,044 49	
(c) Assistants to scientific staff	1,373 94	
(d) Special and temporary services	32 67	
Total		7,902 3
Labor:		
(a) Monthly employees	$751 13	
(b) Daily employees	943 85	
(c) Hourly employees	61 77	
Total		1,756 75
Publications		286 77
Postage and stationery		275 01
Freight and express		219 48
Heat, light and water		801 54
Chemical supplies:		
(a) Chemicals	297 21	
(b) Other supplies	144 21	
Total		441 42
Seeds, plants and sundry supplies:		
(a) Agricultural	$106 42	
(b) Horticultural	130 28	
(c) Botanical	2 96	
(e) Miscellaneous	158 74	
Total		398 40
Fertilizers		128 33
Feeding stuffs		991 27
Library		141 15
Tools, implements and machinery		160 48
Furniture and fixtures		99 08
Scientific apparatus		291 83

Live stock:		
(a) Horses	$75 00	
(b) Cattle	127 50	
(c) Poultry	14 70	
(f) Sundries	228 83	
Total		446 03
Traveling expenses		$289 23
Buildings and repairs		370 89
Total		$15,000 00

ISAIAH K. STETSON, *Treasurer.*

I, the undersigned, duly appointed Auditor of the Corporation, do hereby certify that I have examined the books of the Maine Agricultural Experiment Station for the fiscal year ending June 30, 1901, that I have found the same well kept and classified as above, and that the receipts for the year from the Treasurer of the United States are shown to have been $15,000.00, and the corresponding disbursements, $15,000.00; for all of which proper vouchers are on file and have been examined by me and found correct.

And I further certify that the expenditures have been solely for the purposes set forth in the act of Congress approved March 2, 1887.

A. W. HARRIS, *Auditor.*

Maine Agricultural Experiment Station in account with "General Account" for the year ending June 30, 1901.

DR.

To balance from 1900-1901	$636 00	
Sales of produce, etc	2,714 36	$3,350 36

CR.

By labor	$967 07	
Feeding stuffs	288 04	
Contingent (chiefly insurance and water supply construction)	872 20	
Buildings and repairs	730 00	
Balance to 1900-1901 account	493 05	$3,350 36

Maine Agricultural Experiment Station in account with Creamery Inspection for the year ending December 31, 1901.

DR.

To fees for calibrating glassware	$84 65

CR.

By expense calibrating glassware	$84 65

Maine Agricultural Experiment Station in account with Fertilizer Inspection for the year ending December 31, 1901.

DR.

To balance from account of 1900	$247 37	
Receipts for licenses	2,720 00	
		$2,967 37

CR.

By collection and analyses of samples	$2,141 05	
Executive and office expenses	700 00	
Balance to account of 1902	126 32	
		$2,967 37

Maine Agricultural Experiment Station in account with Feed Inspection for the year ending December 31, 1901.

DR.

To receipts for inspection tags, 1901	$1,408 60	
Balance to account of 1902	834 54	
		$2,243 14

CR.

By balance carried from 1900 account	$666 53	
Collection and analyses of samples	553 71	
Tags	288 74	
Executive and office expenses	700 00	
Interest	24 16	
		$2,243 14

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